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DATAMAP Upgrade Version 4.0

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SUMMARY

This report details the changes made on the data analysis and management program DATAMAP (Data from Aeromechanics Test and Analytics - Management and Analysis Package). These changes are made to Version 3.07 (released February, 1981) and are called Version 4.0. Version 4.0 improvements were performed by Sterling Software under contract to NASA Ames Research Center. The increased capabilities instituted in this version include the breakout of the source code into modules for ease of modification, addition of a more accurate curve fit routine, ability to handle higher frequency data, additional data analysis features, and improvements in the functionality of existing features. These modification will allow DATAMAP to be used on more data sets and will make future modifications and additions easier to implement.

1. INTRODUCTION

The Data from Aeromechanics Test and Analytics - Management and Analysis Package (DATAMAP, refs. 1 and 2) is a computer code which was developed for the purpose of investigating data from the Operational Loads Survey (OLS, ref. 3) test. The high data rates, the large number of grouped sensor arrays, and the sheer volume of the data set dictated the development of a program which could combine the capabilities of various parameter derivations, analysis algorithms, and display codes into one package which could quickly and easily examine and reduce specified sets of data.

The original procedures for obtaining graphs of the OLS data were to submit overnight batch jobs, each of which would generate a multitude of output to be sifted the next day for the figures of interest. If the wrong time set of data was requested, the process would have to be repeated. This process took at a minimum of one day, and often two days to obtain data. In addition, any plots obtained were carefully hoarded, even if it is of no value at that time, for possible future use. It was quickly realized that a program which could examine and analyze the data interactively was required to streamline this data analysis process and DATAMAP was written to fill this need. DATAMAP has since been used with many other data bases, including the Tip Aerodynamic and Acoustic Test (TAAT, ref. 4), pressure instrumented blade tests by the Royal Aeronautical Establishment (RAE), scale-model tests conducted in the DNW, and air-to-air combat simulations.

The first version of DATAMAP was written in 1978 by Bell Helicopter Textron under contract to the Army Research Technology Activity (ARTA) for use on the IBM series 360 computers. The program was subsequently modified to version 3.0 in 1980 (refs. 1 and 2) and version 3.07 in 1981 (described in Appendix A by Richard Philbrick of Bell Helicopter Textron). Version 3.07 included more analysis functions, utility features, and plotting routines, as well as the versatility to handle data from other sources than just the OLS. A version of 3.0 was also written for use with the VAX series of computers (ref. 5) with subsequent upgrade to version 3.07 made for both VAX and IBM computers. This report describes the upgrades from version 3.07 to release version 4.0 that were performed by Sterling Software under contract to NASA Ames Research Center for the VAX computers.

2. BACKGROUND

In general, DATAMAP allows versatile inspection, investigation, and manipulation of time-based data through a stepped command structure. A command step is comprised of four substeps: Specification, Action, Input, and Disposition. At any time, the user can abort the command step and return to the Specification stage by typing CANCEL. Data investigation processes may consist of more than one command step to achieve the final result. For example, to derive the normal force coefficient as a function of azimuth, the user must use three steps: 1) average the raw pressure data, 2) nondimensionalize pressures, and 3) integrate nondimensionalized pressure to obtain normal force coefficient.

A Specification substep indicates the type of process which will be performed (i.e. Analysis, Derivation, Utility, Menu, etc.). The Specification substep must always be present in a command string. However, the presence of the other substeps is not mandatory and is dictated by which Specification function is chosen. Table 1 (obtained from ref. 1) denotes the substeps required for each Specification type.

TABLE 1. REQUIRED SUBSTEPS FOR EACH SPECIFICATION

SPECIFICATION	ACTION	INPUT	DISPOSITION
ANALYZE	•	•	•
DERIVE	•	•	•
DISPLAY		•	•
EDIT		•	
BUILD		•	
SAVE			
NOEDIT			
EXECUTE		•	
MENU		•	
TERMINATE			
COMMENT		•	
SET	•		
UTILITY	•	•*	

* presence depends on specific action substep entered

Action substeps indicate what action should be taken within the confines of the type of process indicated in the Specification substep. For example, for the analyze specification, possible actions would include: cycle averaging, digital filtering, spectral analysis, etc.

The input substep tells where the input data needed to perform the indicated action is located. Choices for this substep include: an individual data stream, a group of data streams specified by an information file, or data previously stored in a scratch file. This substep also allows the selection of specified slices of data, in either time or azimuth, to be processed.

When necessary, the results, of the command sequences are handled in the disposition substep. Output types include tables, plots, and saving data into a scratch file for further processing. The user can choose the independent axis units and output range for tables and plots. Various plotting formats are available ranging from simple one or multiple line two-dimensional (2-D) plots to three-dimensional (3-D) surface plots. In addition, crosshairs can be implemented to return engineering unit values for the displayed plots.

3. IMPROVEMENTS AND CHANGES

This section contains descriptions of the improvements to DATAMAP Version 3.07 contained in Version 4.0. These improvements, listed below, are each described in detail in later sections, with examples given where applicable. Also a command tree structure which includes these improvements for DATAMAP Version 4.0 is shown in figure 1. Modifications to the user interface structure are described in reference 6.

1. Division of code into modules.
2. Cubic spline fit used for integrations.
3. Choice of decades when using log scale on x axis.
4. Increase number of data points in average curve fit from a constant 256 to a user option of up to 2048.
5. Addition of a fourth scratch file.
6. Improvement in program operation when Top, Bottom, or Both are specified.
7. Ability to delete spikes from data
8. Addition of aerodynamic forces and pitching moment derivation.
9. Ability to use separate scratch files as inputs for top and bottom surfaces in force and force coefficient integrations.
10. Ability to average the contents of two scratch files together.
11. Addition of a group within info file structure to handle tapered planform geometry.

3.1 Separation Of Source Code Into Modules

The source code for DATAMAP has been broken into individual module files to ease changing, compiling and linking of the program. There are 274 FORTRAN files (designated by .FOR), and 50 common files (designated by .CMN) contained in this module set. These files are listed in appendix B with a brief description of their purpose.

3.2 Cubic Spline Fit Integration

The original trapezoidal integration routine used by DATAMAP to determine blade aerodynamic loading, has been replaced by a cubic spline fit integration. The spline is an Akima spline method coded at RAE and modified to increase its computational speed by ARTA. The spline integration procedure provides a higher accuracy than does the trapezoidal method. This increase in accuracy is especially necessary in the uneven integration environment inherent to blade surface pressure measurements. A typical effect of the spline technique on aerodynamic coefficients is shown in Table 2.

TABLE 2. EFFECTS OF SPLINE INTEGRATION

	Trapezoidal	Spline
C_n	0.6100	0.6350
C_m	-0.0385	-0.0496

3.3 Choice of Decades for Log X Axis Option

Previously when using the log option on the x axis, the user had limited control of the decades plotted. With the improved option, the user can choose not only the number of decades to plot but also the starting decade. The choice is contained in the disposition substep and has the form:

.../... LOG, (# Decades - Default = 4), (Initial Decade, Default = 1)/

Figure 2 gives an example of a graph using the old log options and the same graph using the new log options.

3.4 Increase Number of Data Points In Averaged Cycle

The original cycle average command used in version 3.07 of DATAMAP defaulted to a representative cycle containing 256 equally spaced data points. Because of the link between azimuth and time, this number yielded an upper frequency ceiling based on rotor speed. This upper frequency limit was acceptable for the TAAT and OLS data bases where the maximum frequency for a transducer output was 400 Hertz. However, the use of DATAMAP with tests having higher frequency resolution necessitated increasing this average number. Version 4.0 incorporates the ability to choose the number of points in the averaged cycle to be 256 to 2048, inclusive. Use of these rates are possible for any data, independent of the raw data sampling rate. However, choosing a higher number of points per cycle than is available in the raw data does not add additional resolution, as shown in figure 3. Conversely, use of a lower number of points in the average than is available will effectively filter the data and reduce the data resolution. The command to perform this average is:

ANAL/AVERAGE (no. of data values to represent a cycle - Default = 256)/...

The initial default number is 256 but once the value is changed within a session, the new value is the default for that session. If a larger number of samples per cycle is requested in the average than is available in the raw data, the warning message shown below will be given and processing at the requested samples per cycle will be completed.

```
** WARNING
** NUMBER OF RAW DATA POINTS FOR ONE CYCLE
** IS LESS THAN REQUESTED POINTS.
** PROCESS WILL BE COMPLETED!
```

3.5 Addition of a Fourth Scratch File

A fourth scratch file, designated SCF4, has been added to increase DATAMAP's ability to handle complex multiple derivation and analysis logic chains. This scratch file is handled in the same way and has the same capabilities as the three original scratch files (SCF1, SCF2, and SCF3).

3.6 Improvement in Program Operation of Top, Bottom, or Both Specification

Previously, when the user saved the bottom position from an information group into a scratch file, the information was placed into the top of the scratch file. This improvement will place the information in the specified top or bottom location in the scratch file. The user must then specify top or bottom when using that data in the input step. The purpose of this improvement is to simplify the dual input processing algorithm and to ensure proper plot labeling.

3.7 Spike Deletion

The spike deletion option has been added to DATAMAP because test data can contain contamination caused by instrumentation or the digitization process. If this contamination is left uncorrected, false results can be obtained when performing derivations or analysis. One method of correcting for this contamination is filtration. However, to keep the full frequency content of the data, another method of eliminating spurious data was developed. This spike option interpolates a straight line between two selected time points which are specified by the user. The spike command takes the form:

ANAL/SPIKE, (x spike interval start time), (x spike interval end time), (all or Row/Col #)/...

The (all or ROW/COL #) input specifies which positions to affect from the specified input substep. For example

ANAL/SPIKE, 0.1, 0.2, ALL / SCF1, ALL, ALL, 3/

will replace data from 0.1 to 0.2 sec from all rows of column 3 of the data stored in scratch file 1. The command

ANAL/SPIKE, 0.1, 0.2, 2 / SCF1, ALL, ALL, 3/

will remove a spike from 0.1 to 0.2 seconds from column 2 of row 3 of scratch file 1. Conversely, the command

ANAL/SPIKE, 0.1, 0.2, 2 / SCF1, ALL, 3, ALL/

will remove a spike from 0.1 to 0.2 sec from row 2 of column 3 of scratch file 1. For example, figure 4 shows a time history before and after the spike command is performed. This command affects only the data stored in the scratch files, not the data stored in the master file.

3.8 Force and Moment Derivation

An option to derive the normal and chordwise forces as well as the pitching moment as units of force has been added. The commands for these options are:

DERIVE/NFOR, (chord length value, in inches - no default)/...

DERIVE/CFOR, (chord length value, in inches - no default), (Trailing edge thickness, % - Default=1) /...

DERIVE/PMOM, (chord length value, in inches - no default)/...

Caution must be taken when using the CFOR results since the actual drag of the airfoil will contain components, such as skin friction drag, which are not taken into account using numerical integration of blade surface pressures.

3.9 Separate Scratch Files for Top and Bottom Surface Inputs

This option allows the user to integrate using the top surface data stored in one scratch file and the bottom surface data stored in a separate scratch file. This option was added as an adjunct to the SPIKE option with the purpose of keeping the results of integration as unaltered as possible. If the one surface contains spikes but the other surface does not, then it is best to keep the clean surface in its original form before integrating. The procedure for using this option is (assuming that the spikes are on the top surface):

1. Perform the spike routine on the top surface and save the pressures to be integrated in the top of a scratch file (i.e. SCF1).

2. Save the bottom surface pressures ready to be integrated in the bottom of a different scratch file (i.e. SCF2).

3. DERI/NFOR 28.3/DUAL, (Top, i.e. SCF!), (Bottom, i.e. SCF2), ...

The results can be disposed in the same manner as any normal integration results would be. Care must be taken in setting up the scratch files as both scratch files must contain the same amount of data averaged with the same step interval or an error will be issued.

Figure 5 shows the output made possible by the addition of a fourth scratch file, the ability to delete spikes, and force derivation using dual inputs. The first curve of this figure shows the normal force derivation without despiking and the second curve shows the effect of the elimination of the spikes on the top surface transducers. The command sequence which generated this figure is the following:

```
ANALYZE/AVERAGE/GROUP S2PA TOP 2 ALL 2156 0 2/KEEP SCF1/
ANALYZE/SPIKE .219 .230 3/SCF1 ALL ALL ALL TOP/KEEP SCF2/
ANALYZE/SPIKE .219 .230 4/SCF2 ALL ALL ALL TOP/KEEP SCF3/
ANALYZE/SPIKE .219 .230 6/SCF3 ALL ALL ALL TOP/KEEP SCF2/
ANALYZE/SPIKE .219 .230 7/SCF2 ALL ALL ALL TOP/KEEP SCF3/
ANALYZE/SPIKE .219 .230 9/SCF3 ALL ALL ALL TOP/KEEP SCF2/
ANALYZE/SPIKE .219 .230 11/SCF2 ALL ALL ALL TOP/KEEP SCF3/
ANALYZE/SPIKE .219 .230 13/SCF3 ALL ALL ALL TOP/KEEP SCF2/
ANALYZE/SPIKE .195 .204 ALL/SCF2 ALL ALL ALL TOP/KEEP SCF3/
ANALYZE/AVERAGE/GROUP S2PA BOTT 2 ALL 2156 0 2/ KEEP SCF4/
DERIVE/NFOR 28.3/DUAL SCF3 SCF4 ALL ALL ALL/KEEP SCF2/
ANALYZE/AVERAGE/GROUP S2PA BOTH 2 ALL 2156 0 2/KEEP SCF4/
DERIVE/NFOR 28.3/SCF4/KEEP SCF3/
COMMENT/NORMAL FORCE DERIVATION WITH SPIKES/
DISPLAY/SCF3 220 320 MRA ALL/LPLOT MRAZ/
COMMENT/NORMAL FORCE DERIVATION WITH SPIKES DELETED/
DISPLAY/SCF2 220 320 MRAZ ALL/APLO MRAZ/
```

3.10 Average Two Scratch Files

To further enhance DATAMAP's ability to handle larger sample rates and longer time histories of data, the ability to cycle average two scratch files together has been incorporated into Version 4.0. The results of this command yield a representative cycle, as does the normal cycle average command, but effectively places no limit to the amount of data which can be averaged. An offshoot of this capability is that one cycle of a time history can be weighted in the average by using it several times. The constraints on this command are that the data in the two scratch files being averaged must contain the same number of samples and have been cycle averaged themselves. The command step to use this option is:

ANAL/AVRCYCL/(1st input: SCF1, SCF2, SCF3, SCF4 - no default), (2nd input: SCF1, SCF2, SCF3, SCF4 - no default) ...

3.11 Addition of Information File Group Type Which will Handle Tapered Planforms

To handle tapered planforms an additional group was added to those available in the info file. This group is designated by the first two letters in the group name being S3. The chord distribution information is contained in the CHORD DISTRIBUTION section which follows the column section (in this case FRACTN OF RADIUS), as shown in figure 6. The units of the distribution are the nondimensional ratio C/CBASE, where CBASE is the chord at the root radial station input during the DERI/force commands. There is one C/CBASE number for each radial station indicated in the column section.

The value obtained for forces and moments from the integration is multiplied by (C/CBASE * CBASE) to get the actual value corresponding to the chord length at a particular radial location.

4. GENERAL SYSTEM CONSIDERATIONS

An effort has been made to enable DATAMAP to be installed on another computer system as simply as possible. However, certain installation and system dependent coding was required to meet the requirements for the NASA Ames VAX 11/785 computer system. Such code is always flagged in the source listings and a corresponding process valid for the local installation can be inserted. DATAMAP is written in VAX-11 FORTRAN which is a superset of PDP-11 FORTRAN IV Plus. Appendix C lists the present hardware configurations presently supported by DATAMAP Version 4.0.

5. ROUTINES NOT SUPPLIED WITH DATAMAP SOURCES

The data sets not supplied with DATAMAP that are required for linking are the Tektronix plotting package PLOT10, and the system FORTRAN library, FORTLIB. These data set names are only for reference as the actual names may be different depending upon the individual computer installation.

6. SETTING UP DATAMAP

A single command file called IMAGE must be run to initialize the DATAMAP system. When this step is performed, DATAMAP will be ready to run if using the master file supplied with the source code. If not using the master file supplied with the source code, DATAMAINT must first be run to create a new master file. The directions for running DATAMAINT are contained in the original DATAMAP Users Manual, reference 1, and have not changed as of this release.

REFERENCES

1. Philbrick, Richard B., "The Data from Aeromechanics Test and Analytics - Management and Analysis Package (DATAMAP) Volume I - Users Manual", USAAVRADCOM-TR-80-D-30A, December 1980

2. Philbrick, Richard B., "The Data from Aeromechanics Test and Analytics - Management and Analysis Package (DATAMAP) Volume II - Systems Manual", USAAVRADCOM-TR-80-D-30B, December 1980

3. Shockey, G. A., Williamson J. W., and Cox, C. R., "AH–1G Helicopter Aerodynamic and Structural Loads Survey", USAAMRD-TR-7639, Bell Helicopter Textron, Feb. 1977

4. Cross, Jeffery L., and Watts, Michael E., "Tip Aerodynamic and Acoustics Test – a Report and Data Survey", NASA-RP-1179, Jan. 1988

5. Philbrick, R. B.,"DATAMAP Installation at NASA Ames Research Center 1980", Bell Helicopter Textron 299-099-021, Oct. 1980

6. Dejpour, Shabob, "DATAMAP Systems Manual Supplement", Sterling Federal Systems TN 10, Aug. 1987

Appendix A

DATAMAP Version 3.07 Processing Program Improvements

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February 12, 1981

1. INTRODUCTION

Bell Helicopter Textron (BHT) has made several improvements to the DATAMAP Processing Program for Contract DAAK51-79-C-0015 and for certain local BHT requirements. The improved version is called DATAMAP Version 3.07. This document is a temporary supplement to USAAVRADCOMTR 80-D-30A, the DATAMAP User's Manual, for Version 3.00. This supplement assumes the reader has read the DATAMAP User's Manual.

These are the improvements to DATAMAP that this document covers:

- DOUBLED PROGRAM-MEMORY PROCESSING AREA
- NUMERIC INTEGRATION
- NUMERIC DIFFERENTIATION
- TRANSITIONAL BUTTERWORTH-BESSEL FILTERING OPTION
- LINEAR ADJUSTMENT TO INPUT DATA
- LOCAL MACH NUMBER DERIVATION
- CROSS PLOT (i.e., any variable versus any other variable with a third variable such as azimuth relating the two)
- USER-ENTERED LABELS FOR USER-ENTERED COLUMN POSITION SCALE
- "SET/BELL/" COMMAND AND "SET/WHISTLE/" COMMAND (to ring Tektronix bell when a command step is completed)
- MAXIMUM NUMBER OF COMMAND SEQUENCE EXECUTION ARGUMENTS EXPANDED TO TWENTY
- PROGRAMMED LOOPING IN COMMAND SEQUENCES
- OPERATING INSTALLATION LABEL IS SET TO A DEFAULT AND CAN BE CHANGED BY THE USER (e.g., "U.S. ARMY ATL" or "NASA AMES")
- UTILITY/PAUSE/ COMMAND AVAILABLE
- TIME INSTANT VALUES RETRIEVED FROM A SCRATCH FILE ARE INTERPOLATED

- SUBINTERVALS OF SCRATCH FILE DATA MAY BE RETRIEVED

- FLAPPING COMPONENT DERIVATION AND CYCLIC AND COLLECTIVE FEATHERING DERIVATIONS

- INFO FILE CALIBRATION TABLE FOR AIRSPEED DERIVATION

- PLOT DATA POINT REPRESENTATION SETTINGS

2. INCREASED PROGRAM-MEMORY PROCESSING AREA

The Processing Program can now read and process time histories that are twice as long as the histories that Version 3.00 could process. The length of the input history that can be processed depends upon the specific process and the number of double-row elements that are processed. Here are the specific limits for input time histories:

PROCESS	ONE DOUBLE-ROW	TWO DOUBLE-ROW
DISPLAY/ . . .	8,192	8,192
ANAL/ACOUSTIC . . .	16,384	8,192
ANAL/SPECTRUM . . .	16,384	8,192
ANAL/HARMONIC . . .	16,384	8,192
ANAL/DAMPING . . .	16,384	8,192
ANAL/AVERAGE . . .	16,384	8,192
ANAL/MMAX . . .	16,384	8,192
ANAL/STATISTICS . . .	16,384	8,192
ANAL/AUTO DENSITY . .	8,192	4,096
ANAL/AUTO CORRELATION	8,192	4,096
ANAL/CROSS CORREL . . .	4,096	2,048
ANAL/CROSS DENSITY . . .	8,192	4,096
ANAL/RESPONSE . . .	8,192	4,096
ANAL/COHERENCE . . .	8,192	4,096
ANAL/INTEGRATE . . .	8,192	8,192
ANAL/DIFFERENTIATE . .	8.192	8,192
ANAL/ADJUST . . .	8,192	8,192
ANAL/COMBINE . . .	8,192	-
Interval retrieve from scratch file	2,048	2,048

Limits for the derivations generally depend on more factors than the number of input points. These factors include number of rotor cycles processed and the attached parameters that are needed for a derivation. Generally, derivations are for a few rotor cycles and should not incur a space limit.

The listed limits are for time history length and do not apply to the total number of data samples that are processed in one step. The limits are valid for each input history for multiple row and column processing, but the scratch file size may limit the total amount of data that can be processed in one command. For example, it is permissible to integrate 8,192 points at a time and multiple row and column elements can be integrated with 8,192 input points for each row/column intersection. However, if there are 200 row/column intersections with 8192 points each and the output is to a scratch file, then the scratch file will overflow.

3. NUMERIC INTEGRATION

Numerical integration is available as a new analysis option. It uses the Simpson's Rule method with some modification. The specific method is from the IBM Scientific Subroutine Package routine "QSF". After the integration, the program will add a linear function to the integrated record so that the start and end values match start and end values entered by the user. Alternatively, the user can enter only the start value, and the program will add that start value to the integrated record. The default start value is zero.

Although the user-interface HELP message indicates that there are three integration methods available (Simpson's, trapezoidal and cubic spline), in fact when the user selects any other method than Simpson's, the program will write an error message.

Here is the form of the Action Substep for integration:

$$\text{ANAL/INTEG (Initial Value)} \left\{ \begin{array}{c} \text{UNSPECIFIED} \\ \\ \text{(End Value)} \end{array} \right\} \left\{ \begin{array}{c} \text{SIMPSONS} \\ \text{TRAPEZOIDAL} \\ \text{CUBIC SPLINE} \end{array} \right\} /\ldots$$

The default initial value is zero, the default end value is UNSPECIFIED, and the default method is SIMPSONS.

4. NUMERIC DIFFERENTIATION

DATAMAP performs differentiation using a differentiating filter. "DIGITAL SIGNAL ANALYSIS" by Samuel D. Sterns describes this method that uses a non-recursive digital filter. The user may specify the number of filter coefficients with allowed numbers from 1 to 30. With one coefficient, the filter is the same as the central difference method. The default of ten coefficients is generally sufficient.

Following is the Action Substep for the differentiation command.

ANAL/DIFFERENTIATE (Number of Coefficients) / . . .

The user should be very cautious with numeric differentiation. High-frequency noise components in the input data will cause huge errors in the computed differential record. Frequency must be judged relative to the sampling rate. Frequency components greater than one-sixth the sampling rate (i.e., number of samples per second or hertz) are considered high. Low pass digital filtering of the input record may reduce the high-frequency noise problem, but the user must ensure that no frequency component of interest is attenuated significantly.

5. NEW DIGITAL FILTERING OPTION

DATAMAP now has a Transitional Butterwoth-Bessel filter in addition to the Chebyshev filter. This filter is of use to reduce the problem of filter "ring" near input data transients such as step functions and impulse functions. However, the disadvantage of this filter is to smooth the sharp "rolloff" characteristics that are considered desirable for a low or band-pass digital filter. The transitional factor, with allowed values between zero and one, governs the degree to which the "ring" is reduced and the rolloff is smoothed. A value of 0.0 implies a pure Butterwoth filter with considerable ring and very sharp rolloff from the pass band. Alternatively, 1.0 means a pure Bessel filter with no ring and smooth, slow rolloff from the pass band.

For this filter option, the user may still specify the number of poles in the filter, and the upper and lower break frequencies. In addition, the user may select a forward-only, one-pass filtering operation instead of the normal two-pass operation that is required with the Chebyshev filter. A one-pass operation will distort the phase of the output record.

Here is the new Input Substep for digital filtering:

$$\text{ANAL/FILTER (Upper Break) (Lower Break) (\# Poles)}\left\{\begin{array}{l}\text{CHEBYSHEV/...}\\ \\ \text{BUTTERWORTHBESSEL (Transition Factor)}\left\{\begin{array}{c}\text{ONE}\\ \text{TWO}\end{array}\right\}\text{/...}\end{array}\right.$$

The ONE and TWO keywords for the Butterwoth-Bessel option control the number of passes for the filter. CHEBYSHEV is the default filter type so that the user need not change existing commands if he does not want to use the Butterworth-Bessel option. The default transition factor is .5 and the default number of passes is TWO.

6. LINEAR ADJUSTMENT TO INPUT DATA

With the linear adjustment capability, the user can add a linear function of time to input data and/or correct the calibration of measured input data. Thus, the user could subtract an undesired trend in an input record, or he could correct a calibration that disagreed with known physical information about the data (e.g., if an accelerometer at rest and oriented vertically did not measure one g). Naturally, the user must exercise great care to report any adjustments to data that are presented.

Following is the Action Substep for the linear adjustment operation:

$$\text{ANAL/ADJUST (Add Constant) (Time Factor)}\left\{\begin{array}{c}\text{UNSPECIFIED}\\ \text{(Input Factor)}\end{array}\right\}\text{/...}$$

Where if

$$y(t) = a + bt + cx(t)$$

x(t) is the original input and y(t) is the adjusted record and then

a = (Add Constant)
b = (Time Factor)
c = (Input Factor)

The default (Add Constant) is 0.0, the default (Time Factor) is 0.0, and the default (Input Factor) is UNSPECIFIED which means 1.0.

7. LOCAL MACH NUMBER DERIVATION

DATAMAP computes local mach number from six input numbers:

- Blade azimuth in degrees
- Rotor speed in RPM

- Helicopter true airspeed in knots
- Rotor tip path plane angle in degrees
- Outside air temperature in degrees Celsius
- Blade radial station in inches

For each azimuth position, the program first computes the speed of sound for the outside air temperature. Then it computes the magnitude of the blade station velocity vector relative to the air mass and divides that number by the speed of sound. The program assumes that the helicopter motion is in the plane of the zero degree rotor azimuth position and the perpendicular to the tip path plane (i.e., it assumes no sideward flight). The program does not consider rotor motions other than the basic rotor speed and the user must enter the tip path plane angle as a constant.

Here is the Action Substep for the Mach Number derivation:

$$\text{DERI/MACH (Rotor Radius) (Tip Plane Angle)} \left\{ \begin{array}{c} \text{CALCULATE} \\ \text{(Temperature)} \end{array} \right\} /\ldots$$

The default (Rotor Radius) is the same as the default for the CP derivation. The default (Tip Plane Angle) is 0.0 degrees and the default outside air temperature is the same as the default for this entry in the several other derivations that require temperature.

The input must specify blade station as column position in percent of tip radius. GROUP input from the info file or scratch file input could satisfy this requirement. This derivation ignores and discards time history input and only uses the accompanying blade station and azimuth data. For example, suppose that scratch file SCF3 contained normal force coefficient, Cn, data for several blade stations and one rotor revolution. Then the command

DERI/MACH 264 0 CALC/SCF3/KEEP SCF1/

will produce Mach Number values on scratch file SCF1 that correspond station by station and azimuth position by azimuth position to the CN values in SCF3. These values can be compared with ANAL/COMBINE/. ./XPLOT . . . / command (see Section 8.).

8. CROSS PLOT

With the cross plot, the user can request a plot of one dependent variable versus another dependent variable as related by an independent variable for both functions. For example, lift can be plotted against drag as related by azimuth. A cross plot is like a single or multiple curve X-Y plot, but loops can occur on the plot so that there can be more than one vertical - axis value plotted for a particular horizontal axis value.

To obtain a cross plot, the user must specify the COMBINE analysis:

ANAL/COMBINE/ . . .

COMBINE is not really an analysis, but instead is simply a combining of two input functions, so that the program can plot them together. The input substep must specify two scratch files as input.

$$\text{ANAL/COMBINE/}\left\{\begin{matrix}\text{SCF1}\\ \text{SCF2}\\ \text{SCF3}\end{matrix}\right\}\left\{\begin{matrix}\text{SCF1}\\ \text{SCF2}\\ \text{SCF3}\end{matrix}\right\}\ldots$$

and the balance of the input Substep is the same as the DISPLAY input Substep after a scratch file is specified. The Disposition Substep has three initial options, XPLOT, XLPLOT and APLOT where XPLOT means create a new cross plot, XLPLOT means create a new special annotation cross plot and APLOT means add a curve to an existing cross plot. The subsequent Disposition Substep entries have the same options as those that follow the MPLOT, LPLOT and APLOT entries for the DISPLAY command. However, the meaning of the second substep entry is slightly different. The independent variable is the variable that relates the two variables that are plotted. When the independent variable is time related, then the curve is annotated with special centered characters at "nice number" intervals of the independent variable. When the independent variable is row or column position, the special characters are drawn at the data points.

DATAMAP draws the cross plot with the two dependent-variable function labels included in the axis annotations. It draws the label for the independent variable and the spacing of the centered character annotation under the plot. The proportion of the cross plot is square and thus slightly different from the other X-Y plots so that the expanded vertical axis label will fit. Figure A1 shows a typical cross plot with azimuth used as the associating independent variable.

As the APLOT disposition option indicates, DATAMAP will draw a cross plot with multiple curves. No more than eight curves may be drawn on a cross plot. DATAMAP draws each curve with a different dash-dot pattern and/or a different special centered character. Figure A2 shows an annotated cross plot (XLPLOT) with two curves showing behavior at different airspeeds. For XLPOT output, only one curve may be drawn on a plot for each command step and no more than two or three curves can be annotated at the bottom of a plot.

9. USER-SPECIFIED LABELS FOR COLUMN POSITION SCALE

When the user makes multiple ADD's to a scratch file to create several columns, he may enter the column positions in the Disposition Substep. Under Version 3.07, he may also enter a label for the column position axis. He must enter this label in the command to save the first column on the scratch file (i.e., in the KEEP step). Here is the form of the Disposition Substep:

$$\ldots\text{/KEEP}\left\{\begin{matrix}\text{SCF1}\\ \text{SCF2}\\ \text{SCF3}\end{matrix}\right\}\text{(Column Position) (Column Position Label)/}$$

This label may contain as many as 16 characters and should be enclosed in single quotes. If this label is eight characters or less, both the short and long column position labels will be set to this string. DATAMAP uses the short label for curve annotation on multiple curve plots.

10. "SET/BELL/" AND "SET/WHISTLE/" COMMANDS

DATAMAP provides the BELL and Whistle options so that the user can set the program to ring the Tektronix bell and attract his attention when the program completes a command step. Sometimes, command steps require a great deal of computer CPU time or the computer response is slow for interactive operation. If the user wishes to direct his attention elsewhere during command execution, he can set the BELL or WHISTLE mode to ring the Tektronix bell when each step is complete. BELL mode means that the Tektronix bell is rung once when the program completes a command steps. WHISTLE mode means that the Tektronix bell is rung several times in quick succession when a step is complete. Here are the bell and whistle setting commands:

```
      ( BELL      )
      ( NOBELL    )
SET/ <            > /
      ( WHISTLE   )
      ( NOWHISTLE )
```

NOBELL unsets the BELL mode and NOWHISTLE unsets the WHISTLE mode. Do not set the BELL or WHISTLE mode in the batch or interactive (i.e., other than interactive graphics) modes.

11. COMMAND SEQUENCE EXECUTION ARGUMENTS

A command sequence block may use as many as twenty execution arguments numbered %1 through %20. An EXECUTE command may include as many a twenty "%" arguments. For example:

EXECUTE/ABCD %D001 %D010 %.5 %0 %50 %.15 %610 %0 %.26 %611
%200 %.05 %612 %400 %.24 %613 %600 %.13 %614 %800/

12. PROGRAMMED LOOPING IN COMMAND SEQUENCES

DATAMAP will now recognize five special procedural statements within a command sequence. A procedural statement must appear on one line and must have an asterisk in column one. The syntax for the five kinds of procedural statements is:

*LABEL (Address)
*GOTO (Address)
*IF (%Parm# or Const) (Rel) (%Parm# or Const) GOTO (Address)
*ADD (%Parm# or Const TO (%Parm#)
*SET (%Parm#) TO (%Parm# or Const)

The Parentheses above enclose short descriptions for appropriate entries: they do not appear in the actual procedural statements. Following are the meanings for each of the short descriptions.

(Address) = Nonnumeric address label of as many as four characters (extra characters are ignored)
(%Parm#) = A parameter number (numbers 1 through 20 allowed) preceded by the "%" character (e.g., %15)
(Const) = A string or numeric entry as restricted for normal DATAMAP entries. String constants are only allowed in the "SET" statement.
(Rel) = One of the five relationships:

GT = Greater Than
GE = Greater Than or Equal To
EQ = Equal To
LE = Less Than or Equal To
LT = Less Than

The LABEL statement marks a location in the sequence for the GOTO (unconditional jump) and the IF (conditional jump) statements. When the program reads a GOTO statement or an IF statement with the specified condition satisfied, it searches for a label statement with the indicated address. If it finds this address, it then reads the line following the corresponding LABEL statement. If it cannot find the address, it stops executing the command sequence.

Following is an example of a command sequence with looping.

```
*SET %20 TO %1
* LABEL L001
ANAL/AVER/GROUP  S2PA , , , , %20 %2 %3/KEEP SCF1/
DERI/CP %4/SCF1/KEEP SCF2/
*  SET %19  TO  1
*LABEL  L002
DISP/SCF1 ALL ALL %19/DPLOT  MRAZ/
*ADD  1  TO  %19
*IF  %19  LE  8  GOTO  L002
*ADD  1  TO  %20
*IF  *20  GT  %4  GOTO  L001
*NOEDIT
```

13. OPERATING INSTALLATION LABEL

DATAMAP plots now include an operating installation label beside the version and date label. For example, on figures A1 and A2 this label is "BELL HELICOPTER". This label can be as long as 20 characters. The program block data includes a default label that should be set for each DATAMAP installation. The user can change this label with the UTILITY command:

UTILITY/OPERATOR/'(Label)'/

Enclose the label in single quotes. The user can enter and reenter this label at any time during the program run.

14. "UTILITY/PAUSE/" COMMAND

Use this command in command sequences for interactive execution. Suppose that the user wants to run a command sequence that computes Cn from pressure data and that draws a contour plot of Cn and a multiple curve plot of the blade tip Cp stations as an intermediate result. Suppose also that the user wants to execute this sequence interactively. With good computer response, the Cp plot could be erased before the user could look at it. With a pause command before the contour plot command, the program will write a message and wait for the user to depress the "enter" or "return" key before executing the contour plot command. The program ignores this command in batch mode. The command is:

UTILITY/PAUSE/

15. TIME INSTANTS INTERPOLATED FOR SCRATCH FILE RETRIEVAL

For previous DATAMAP versions, when the user specified a time or azimuth instant for scratch file retrieval, the program took the closest time instant that was actually stored, provided that the requested instant was within the range of stored values. In Version 3.07, the program uses a simplified cubic spline interpolation to estimate values at the instant requested.

A closely related improvement is that, for the special case of cycle-averaged input data, the user may now specify exactly 0.0 or 360 degrees azimuth as the selected instant for input. These values are slightly outside the range of azimuth values stored for cycle-averaged data. Now, the program extends a cycle average input record by assuming continuity between the beginning and end of the record.

16. SUBINTERVALS OF SCRATCH FILE DATA MAY BE RETRIEVED

Previously, the user could choose from two options when he selected from the domain of first dimension or first independent variable values stored on a scratch file. He could select the full domain (i.e., ALL values) or he could select a single instant. In Version 3.07, he may select all, an instant, or a sub-interval of the full domain. For all Input Substep sequences where the user could specify ALL or an instant in the previous version, here are the corresponding entries for Version 3.07:

```
            [ALL                                          ]
... [SCF1]  [                                             ]
    [SCF2] -[            [IMPLIED                         ] ...
    [SCF3]  [            [MRAZ                            ]
            [(Value) -   [TAS                             ]
                         [MRPM                            ]
                         [                   [IMPLIED     ]
                         [(End Value)  -     [MRAZ        ]
                                             [TAS         ]
                                             [MRPM        ]
```

The entry (Value) is either an instant or the beginning of a subinterval. Notice that commands to specify the full first independent variable domain (i.e., ALL) and to specify an instant of that domain do not change in Version 3.07. However, the user may now specify, for example.

DISP/SCF1 225 315 MRAZ 1 ALL TOP/SURF RECT MRAZ,,8 10 6/

to request a surface plot of the top-surface leading-edge sensors for 226 through 315 degrees azimuth. Figure A3 is such a plot. Compare figure A3 with figure A4, which is a plot that spans all 360 degrees of azimuth and cannot show detailed variation with azimuth.

17. FLAPPING COMPONENT AND CYCLIC AND COLLECTIVE FEATHERING DERIVATIONS

DATAMAP computes the longitudinal and/or lateral flapping components from blade flapping data, the longitudinal and/or lateral cyclic feathering components from blade feathering data, and the collective pitch from blade feathering data. These derivations also use azimuth information for the harmonic computations. Here are the Action substep command entry variations for these derivations.

```
        { {FLAPPING} {LONGITUDINAL} }
DERIVE/ { {CYCLIC  } {LATERAL     } } (Correction Slope) (Correction Intercept)/(Counter)...
        {       COLLECTIVE          }
```

The keywords "LONGITUDINAL" and "LATERAL" select the component of prime interest for the flapping and cyclic feathering derivations. However, both components are always computed with the named component stored as the "TOP" double-row and the unnamed component becoming the "BOTTOM" double-row. Thus if the user specifies "LATERAL", the program stores the lateral component as the "TOP" double-row element and it stores the longitudinal component as the "BOTTOM" double-row element. PLOT, MPLOT, LPLOT and XPLOT disposition will show only the "TOP" double-row while DPLOT and PRINT Disposition show both double-rows. The collective derivation produces a single double-row element. The default correction slope entry is 1.0 and the default correction intercept is 0.0.

The Info File identifies the flapping item code in the initial group with the keyword MFLP for main rotor and TFLP for tail rotor. It identifies the feathering item code with the keyword MFTH for main rotor TFTH for tail rotor. After each item code that follows one of these keywords, the info file may include three correction numbers. The first number is the azimuth correction angle in degrees. This number is the azimuth of the blade that is measured for flapping or feathering when the measured azimuth is zero. Measured azimuth means the azimuth from the azimuth item code after the overall azimuth correction angle following that item code is applied. Thus, the flapping or feathering correction angle is applied cumulatively with the overall azimuth correction angle. The second and third numbers are correction slope and correction intercept for the data. The program uses these values, if present, to recalibrate the input data unless the user enters non-default correction values in the derivation command. Thus, the command-entered correction values override the info file values if they are different from the default values. Following is a typical example of info file initial group entries for the flapping and feathering item codes.

```
.
.
MFLP  D040  45  - 1.00  0.0/
MFTH  D041  45  /
.
.
.
```

The entries designate D040 as the main rotor flapping item code and D041 and the main rotor feathering item code. The azimuth entries for both items indicate that the signal corresponds to 45 degrees azimuth when the measured signal with overall correction applied is 0.0 degrees azimuth. The correction entries indicate that the polarity for the flapping item code is reversed but otherwise correct in magnitude. There is no correction for the feathering item code other than azimuth. No tail rotor flapping or feathering item codes are designated.

Flapping and cyclic feathering are computed using a harmonic analysis of four, two or one rotor cycles of data (as available). That is, if

$$S(t) = C + A*COS(2*\pi*f*t) + B*SIN(2*\pi*f*t) + \ldots$$

where:

S(t)	=	flapping or feathering signal
f	=	rotor frequency in hz
t	=	time shifted to 0.0 for blade over tail boom
C	=	constant term
A	=	1/rev cosine term
B	=	1/rev sine term

Then for a flapping input signal, S(t)

-A	=	longitudinal flapping
-B	=	lateral flapping

and for a feathering input signal

-A	=	lateral cyclic
-B	=	longitudinal cyclic

The output units are the same as the input units but the program labels the output as "degrees" so the user should provide correction factors to convert the input to degrees and, if necessary, to correct the polarity of the measurement.

The program performs the above computation for one, two, or four rotor cycles centered about each azimuth = 0 degrees point. Then the program interpolates to obtain the sample rate and record length as the input data. Naturally, the resultant record will be quite smooth and frequency components at or above the rotor frequency will be greatly attenuated.

The program derives collective pitch angle by computing the mean value of the feathering signal over one, two or four rotor cycles centered about each azimuth = 0 degree instant. Then these values are interpolated as for the flapping and cyclic derivations.

18. INFO FILE CALIBRATION TABLE FOR AIRSPEED DERIVATION

The original DATAMAP documentation describes the derivation of true airspeed (Vol. I, Paragraph G.2.2.). This derivation has been expanded to allow an indicated airspeed to calibrated airspeed conversion table instead of the single linear function conversion that was allowed previously. The calibration table, if present, is stored on the info file and may contain as many as 16 indicated airspeed/calibrated airspeed pairs. The program performs linear interpolation between adjacent pairs and, if indicated airspeed exceeds the range of the table, it performs linear extrapolation from the nearest pair of adjacent points on the table. The user can still enter a linear function for this conversion in the derivation command. If he enters slope and intercept values other than the default values of one and zero, these override the info file table. If there is no Info File airspeed calibration table and the default slope and intercept values are specified in the command, then the indicated airspeed values are used directly as calibrated airspeed values.

n the Info File, the calibration table must follow the airspeed item code that it applies to. The table is a sequence of pairs of an indicated airspeed value followed by a corresponding calibrated airspeed value. Each pair of values and the numbers within each pair must be separated by a comma or blank. The indicated airspeed values must be in ascending order. The table may continue on subsequent lines following the item code. For example:

```
          .
          .

TIAS  P002  0.0  0.0  70  72.5  100  104.5
      131  135  160  160/
          .
          .
```

19. PLOT DATA POINT REPRESENTATION SETTINGS

The user can now control how X-Y and cross plots depict data points. Earlier DATAMAP versions use the following protocol.

- X-Y plots draw curves connecting data points with straight lines. Data points are not specifically marked except,perhaps, as slope discontinuities in the curves. The exception to this rule is for X-Y plots of harmonic analysis output where the harmonics are represented as symbols.

- Cross plots draw curves connecting data points with straight lines. A centered square marker is always drawn at the first data points. When the associating independent variable is column or row position, centered markers are drawn at the data points. When the associating variable is time or azimuth, centered markers are drawn at "nice-number" intervals of this variable (for a domain of 360 degrees, this interval is 10 degrees). Otherwise the data points are not marked.

In Version 3.07, the user may enter the following "SET" command keywords to control the data point representation.

$$\text{SET/}\left\{\begin{array}{l}\text{AUTOPOINT}\\ \text{SYMBOL}\\ \\ \text{LINE}\\ \text{CONNECT}\end{array}\right\}/$$

"AUTOPOINT" is the default setting and instructs the program to use the previously described protocol.

"SYMBOL" Introduces a new protocol.

- X-Y plots do not draw curves connecting data points. A special centered marker is drawn at every M'th data point where M is determined from N, the number of data points.

$$N = \text{INT}((N + 69)/70)$$

Thus, for 70 or fewer data points, every data point is represented as a marker. Figure A5 is an MPLOT of Cn data versus azimuth with "SYMBOL" set.

- Cross plots do not draw curves connecting data points. The first point is marked with a centered square. Every other point is marked with another centered marker.

"LINE" is a different protocol.

- X-Y plots draw curves connecting points with straight lines. Data points are not specifically marked, even for harmonic analysis output.

- Cross plots mark the first point with the centered square and then connect all points in sequence with straight lines.

"CONNECT" combines the protocol of "SYMBOL" and "LINE".

Any settings remains in effect during a run until the user changes it.

Notice that the user can change this setting before entering a command with an "APLOT" disposition. Thus, the user can create plots with one sequence of points drawn with a curve and another sequence of points drawn with centered markers. Figure A6 shows a comparison of Operational Loads Survey (OLS) and C81 data.

Appendix B

Table B1. Subroutine Locations and Descriptions

File Name	Subroutine	Description
SAAMAIN		This is the main overlay for the DATAMAP interactive or batch processing program
SBLKDAT		DATAMAP processing program block data
SACORRL	ACORRL	Calculates auto–covariance function
SACORST	ACORST	Interface to auto-correlation program 'ACORRL' and perform ensemble averaging of results if required
SADENST	ADENST	Interface to auto-spectral density program 'ASDENS' and perform ensemble averaging of results if required
SADJUST	ADJUST	Interface and processing routine for "ADJUSTMENT" analysis
SAERCOF	AERCOF	Calculates (1) normal force coefficient (2) chordwise force coeffiecient, or (3) quarter chord pitching moment coefficient
SAERINT technique	AERINT	Integrates chordwise pressure distributions (Array Y as a function of Array X) to give the integral defined. The routine uses a spline due to AKIMA
SAERFOR	AERFOR	Calculates normal force, chordwise force or pitching moment
SAERSLP	AERSLP	Calculates airfoil surface slopes required in the integration of the force and moment coefficients
SAKIMA	AKIMA	Modified spline technique for curve fitting a function with discontinuities
SALLATT	ALLATT	Airspeed calibration from info file data
SALLSCR	ALLSCR	Checks and initializes scratch parameters and initialize scratch files
SAMPSET	AMPSET	Interface for amplitude spectram calculation
SAMPSPC	AMPSPC	Gets amplitude spectrum, applys cosine taper or Hanning window, fourier transforms, applies summing of adjacent points to get correct peak values
SANMODE	ANMODE	Dummy suboutine to replace Tektronix PLOT-10 in batch version of DATAMAP
SZANNOT	ANNOT	Annotates an axis including caption and scale

Table B1. Continued

File Name	Subroutine	Description
SZAREA	AREA	Specifies allowed plotting area if axes is not called
SASDENS	ASDENS	Calculates single-sided auto-spectral density
SATTGEN	ATTGEN	Interpolates one of the attached parameters: true airspeed, main rotor RPM, or tail rotor RPM so that a constant scale interval is obtained
SATTGET	ATTGET	Gets attached parameter data for counter and time interval
SATTPSC	ATTPSC	Transfers attached parameter values from scratch file to core in 'ATTPAR' common block
SAVECYC	AVECYC	Computes an average cycle of values
SAVRCYCL	AVRCYCL	Calculates the average cycle of two input data sources
SZAXES	AXES	Plots axes and grid with titles and scale annotation
SAZIMTH	AZIMTH	Derives a sequence of times corresponding to blade azimuth
SAZMGEN	AZMGEN	Generates a stream of azimuth values with a constant small sample rate for azimuth time history output
SBANNOT	BANNOT	Provide the general plot annotation for cross plots
SBLDISP	BLDISP	Computes the blade displacement for a certain harmonic number
SBUTBES	BUTBES	Calculates coefficients for band-pass transitional Butterworth-Bessel filters of orders 2-8
SCCHANGE	CCHANGE	Returns the real components of a character string
SCHISQR	CHISQR	Performs chi-square test for goodness-of-fit to a normal distribution
SCHITST	CHITST	Interface for chi-square test routine 'CHISQR'
SCOHRAD	COHRAD	Performs initial calculation of two auto-spectral densities and one cross -spectral density and add these to accumulator area for subsequent coherence function calculation
SCOHREN	COHREN	Completes the calculation of coherence function from ensemble averaged auto- and cross-spectral densities of two processes
SCOHRST	COHRST	Interface and overall control routine for generating the coherence function

Table B1. Continued

File Name	Subroutine	Description
SCOMBST	COMBST	Interface to take two processing input functions and join them to form the top and bottom double-row elements for the output (which must be to a cross plot, "XPLOT")
SCOMPGP	COMPGP	Locates an 'INFO FILE' geometric group and calls subroutine 'READGP' to read and translate it
SCOMPSC	COMPSC	Called if process input is to be from scratch file
SCONCYL	CONCYL	Called by 'CONSET' to draw cylindrical format contour plot
SCONNEC	CONNEC	Called by 'CONTUR' to actually draw the contour lines generated
SCONREC	CONREC	Called by 'CONSET' to draw rectangular contour plot
SCONSET	CONSET	Sets up two dimensional matrix of values for contour plotting and executes 'CONREC' or 'CONCYL'
SCONTUR	CONTUR	Finds contour lines of equal dependent variable value from a two dimensional matrix of values
SCONVCK	CONVCK	Searches array 'IUNCNV' and the info file for a unit conversion specification for a particular unit label and, if found, return the new unit label and the conversion
SCONVCL	CONVCL	Converts counter stored as an integer to a string
SCUBFIT	CUBFIT	Performs interpolation using local cubic polynomials
SCUBINF	CUBINF	Searches thru an input array for missing value flags and insert missing value flags in the output array where interpolation cannot be performed
SCYAVST	CYAVST	Called by 'PRO1' to set up for cycle averaging
SDAMPR	DAMPR	Uses the moving block analysis method to estimate the damping associated with some known frequency
SDAMPST	DAMPST	Set up for call to 'DAMPR' damping estimation routine
SDASTRT	DASTRT	Initialize access to a partition of the master file thru the first partition access slot
SDATAIN	DATAIN	Input the data from a partition of the master file
SDATMAPLE	DATEQQ	Routine to interface with the VAX 11/780 system routine 'DATA' and reformat the date string returned to fit within eight characters as assumed by DATAMAP

Table B1. Continued

File Name	Subroutine	Description
SDAXES	DAXES	Sets two plotting areas, one above the other with the same horizontal scale and annotation but different vertical scales and annotations
SDBWTST	DBWTST	Interface for acoustic weighted integration analysis
SDENALT	DANALT	Computes density altitude, HD, as a function of time
SDERIV	DERIV	Computes a vector of derivitive values given vectors of argument and corresponding function values
SDFILTR	DFILTR	Interface for Chebyshev or transitional Butterworth-Bessel recursive digital filtering
SDIFFIL	DIFFIL	Computes the time derivative of an equally spaced discrete function using a non-recursive filter
SDIFFOVRC	DIFFOVRCL	A hook for differentiation along radial position
SDIFFST	DIFFST	Interface for differentiation of a function over time
SZDINTPT	DINTPT	Finds power of 10 of grid interval for plot
SDIRLIN	DIRLIN	Draw and label surface plot axis extensions
SDISPOS	DISPOS	Called in process overlay to carry out final disposition of data
SDLYNX	DLYNX	Calls 'LYNX ' to draw curve on the top plot area of two allowed plotting areas for the 'DPLOT' option
SZDRAW	DRAW	Draws a line from previous position to X1, Y1. Draws various kinds of dashed lines
SZDRAWN	DRAWN	Utility routine for using 'DRAW' to create lines outside the plotting area (for labeling) and for relocating the origin
SDSPSET	DSPSET	Sets up and calls 'BLDISP' to extract blade displacement in inches for a given rotor harmonic
SDUMPER	DUMPER	Print routine
SDUMPIT	DUMPIT	Dump after a step entry
SEDCNTL	EDCNTL	Entry point for the editor overlay
SEDINIT	EDINIT	Initializes the edit function for a run
SEDINP	EDINP	Provides lines of stored input to the 'LININP' routine

Table B1. Continued

File Name	Subroutine	Description
SEDITCH	EDITCH	Provides the facility for 'CHANGE' activity within the edit mode
SEDITLS	EDITLS	Lists the command sequence block on the command sequence
SEDPADD	EDPADD	Performs the "ADD" procedural command during execution of a command sequence
SEDPIF	EDPIF	Performs the "IF" procedural command so far as determining whether a jump should be made
SEDPJMP	EDPJMP	Searches the current command sequence for a specified address label and changes the current line pointer to the line number for that label
SEDPROC	EDPROC	Processes a command sequence during execution of the sequence
SEDPSET	EDPSET	Performs the 'SET' procedural command during execution of a command sequence
SEDSAVE	EDSAVE	Saves current command listing on the 'EDIT' file command sequence previously specified in 'EDCNTL'
SZENPLT	ENPLT	Terminates plotting
SEXPMAT	EXPMAT	Controls the examination of the input array for missing points
SFCOEF	FCOEF	Calculates Chebyshev type 1 filter coefficients
SFFT	FFT	Calculates discrete fourier transforms using the Cooley-Tukey algorithm
SFILFLP	FILFLP	Controls the filtering of the data in 'Y'
SFILLIN	FILLIN	Fills in all the missing points (equal to -1.E35) in 'XIN' if possible by using local cubic polynomial
SFILTER	FILTER	Calculates filter response using data in common to define filter characteristics
SFINDIT	FINDIT	Locates counter in counter directory or item in item code directory
SFINDT	FINDT	Scans attached parameters for a particular value and returns a time corresponding to that value
SFINDX	FINDX	Directory retrieval routine for menu display
SFLFTST	FLFTST	Interface for blade flapping or for cyclic or collective feathering derivations

Table B1. Continued

File Name	Subroutine	Description
SELPFTH	FLPFTH	Derives the first harmonic cosine and sine terms or the DC term as a function of rev number for an input record of flapping or feathering for an individual blade
SFLTRN	FLTRN	Constant width narrow band analysis from BHT program 'KDAE01'
SFLTRO	FLTRO	Octave band, analysis, from BHT program 'KDAE01'
SFLTRT	FLTRT	Computes filter response using the trapezoidal rule to approximate the convolution integral
XFLTR3	FLTR3	One third Octave band analysis from BHT program 'KDAE01'
SFLWDIR	FLWDIR	Computes the magnitude and direction of local blade air flow using pressure measured by a boundary layer button
SFLWSET	FLWSET	Routine to set up for calls to 'FLWDIR' to calculate boundary layer button flow magnitude and direction
XFMS	FMS	Finds location from mass storage record number 'NREC'
SFREEIN	FREEIN	Obtains a single line of free-form input from the user in the 'EDIT-CHANGE' mode
SGETDAT	GETDAT	Data input for input/process/output sequence
SGETEMP	GETEMP	Gets data into appropriate scratch space for operation using multiple row position measurements
XGET1	GET1	Reads data from an item code counter pair according to time and duration instructions given by user
SGTFORM	GTFORM	Performs perspective transformations on points in three dimensional space
SGUNITS	GUNITS	Creates a product or squared units descriptor for output data resulting from processing that involves multiplication of input data streams
SHARMNY	HARMNY	Sets up for call to 'HARMRV' or 'HARM1' harmonic analysis routines
SHARMRV	HARMRV	Harmonic analysis routine computes the amplitude and phase (in degrees)
XHARM1	HARM1	Harmonic analysis routine computes the amplitude and phase (in degrees) for the desired harmonic number
SHELPR be	HELPR	Given the current tree position of the input step, will list all the options for the current entry and every subsequent entry that can predicted given the current position

Table B1. Continued

File Name	Subroutine	Description
SIBCIEU	IBCIEU	Performs two-dimensional interpolation of matrices using cubic splines
SIFFT	IFFT	Reconstructs the function given the fourier coeficients
SINFOST	INFOST	Reads and interprets the first group of the 'INFO' file
XINFO2	INFO2	Extracts item codes(s) and position(s) as specified by an 'INFO' file group for a given row and column
SINFRED	INFRED	Lists a menu of the group names and titles in an 'INFO' file and the initial group of the file
SINFSCR	INFSCR	Reads in and transfer a scratch file directory base to the scratch input base storage area
SINISTP	INISTP	Initializes allowed defaults as well as some other variables for a new step command
ISYMBPACK	INISYM	Builds an index array for all the plotted characters
SINITSC	INITSC	Initializes one of the scratch files 'SCF1', 'SCF2', or the temporary scratch file
SINPATT	INPATT	Called by 'ALLATT' to input attached parameters OAT, static pressure or true airspeed
SINPSET	INPSET	Called by 'PROCES' to set the input mode and dimensionality for command execution
SZINSET	INSET	If using Tektronix emulator, move cursor to position for interactive I/O according to LNCNT
SINTCMP	INTCMP	Called by 'PROCES' to tie up loose ends after integrations along row positions
SINTERP	INTERP	Interprets one user entry for the DATAMAP processing program
SINTGST	INTGST	Processing interface for integration of a function over time
SINTGOVRC	INTGOVRCL	Called by 'PROCES' to set up for differentiation along column positions
SKCHECK	KCHECK	Compares a keyword against a list and returns special units label for a matched keyword
SLABSET	LABSET	Gets various plot/print labels in alphanumeric form

Table B1. Continued

File Name	Subroutine	Description
SLININP	LININP	Called by 'USER' to input a new line of user instructions from system input or the command sequence file and scan the line
SZLINT	LINT	Draws solid or dotted line from (X1, Y1) to (X2, Y2)
SLISTAD	LISTAD	Builds a list of user entries for the current step in string form
SLISTER	LISTER	Merges and lists a sequence of commands
SLSCRAT	LSCRAT	Reads the scratch file directory bases and list the contents of the file for the user
SZLYNX	LYNX	Plots a line on Calcomp, DP-1 or Tektronix
SMACHDR	MACHDR	Derives the Mach number for the free-stream motion of air relative to a position on the blade
SMACHDST	MACHST	Interface for Mach number computation
SMATCHR	MATCHR	Alphanumeric sequences input string is compared character by character with a test matrix until an unambiguous match is found
SMAXMIN	MAXMIN	Finds minimum and maximum values for a data sequence
SZMCHAR	MCHAR	Plots the indicated character at current pen location
SMCOUNT	MCOUNT	Lists a menu of counters present in the data set being used
SMENINF	MENINF	Gets some data from item/counter info record for item code menu display
SMENSET	MENSET	Displays the current run settings
SMENU	MENU	Menu display overlay and block to call the proper routine for the desired menu
SMERGER	MERGER	Merges new line information with old information
SMINMAX	MINMAX	Computes the oscillatory and mean values for each cycle of the input array
SMINXST	MINXST	Sets up for Min/Max processing
SMITEMS	MITEMS	Lists a menu of item codes present in the data set for a given counter
SMNMASK	MNMASK	Displays a list of the item codes that are currently masked
SMPARTS	MPARTS	Displays the partitions in the Master file
SMPARTX	MPARTX	Displays the partitions in the Master file

Table B1. Continued

File Name	Subroutine	Description
SMULTPL	MULTPL	Draws multiple curve plot
SNARRST	NARRST	Controls execution of acoustic narrow band analysis
SNBFILT	NBFILT	Derives a constant band width acoustic sound pressure level spectrum using a narrow band filter scan in frequency
SNETWAT	NETWAT	Performs weighted integration using the A, B, C, D and overall weighting networks
SNETWKS	NETWKS	Performs integration of noise spectrum using A, B, C, and D weighting networks, from BHT program 'KDAE01'
SNOFRST	NOFRST	Sets up Row/Column Matrix when no first dimension variation is present
SNOYTB	NOYTB	Noy value calculation from BHT program 'KDAE01'
BNPLDEVTF	NPLDEV	Returns plotting device number in a specific load module for batch processing
INPLDEVTF	NPLDEV	Returns plotting device number in a specific load module in the DATAMAP Processing program for interactive processing
SNTOSTR	NTOSTR	Converts a floating number to a string representation with roundoff
SOCTAVE	OCTAVE	Performs Octave or third Octave analysis of input data using FFT procedure and routines 'FLTR0' and FLTR3
SOCTVST	OCTVST	Interfaces DATAMAP to Octave and third Octave analyses
SOUTSET	OUTSET	Sets output information and compares dimensionality of input as modified by process to allowed dimensions of output
SPACK	PACK	Packs 4 characters which are individually left justified in four 32 bit word
SPARTCG	PARTCG	Add, change, or delete one of the two Master file partitions that may currently be accessed by the processing program
SPCVDN	PCVDN	Calculates perceived noise level, routine from BHT program 'KDAE01'
SPLCOPY	PLCOPY	Transfers the Calcomp 'PLOT' arguments to create one plot frame from the temporary frame storage file to the multiple frame storage file
SZPLOC	PLOC	Evaluates a point on Tektronix screen in user coordinates as specified by screen X-Y cursor

Table B1. Continued

File Name	Subroutine	Description
BCCDIPFIL	PLOTS	Partial emulation of the Calcomp 'PLOTS' routine for use in writing a Device Independent Print file
BDUMMYS	PLOTS	Partial emulation of the Calcomp 'PLOTS' routine for use by the interactive mode of DATAMAP
SPLSURD	PLSURD	Driver for three dimensional surface plotting
SPLSURF	PLSURF	Actually draws surface plot
SPNLCAL	PNLCAL	Performs perceived noise level calculation on input acoustic data
SPNLDST	PNLDST	Interface DATAMAP to acoustic perceived noise level analysis
SPOWGEN	POWGEN	Gets attached parameter data and calls up proper routine to compute shaft horsepower, thrust coefficient, torque coefficient or density altitude
SPRCFST	PRCFST	Interface for static pressure coefficient calculation
SPROCES	PROCES	Main routine of the retrieval/processing/disposition overlay, also called the processing block
SPROSET	PROSET	Assigns a number to processing option requested and determines what kind of data is required for the process
XPRO1	PRO1	Finds the proper process set up and calls a routine to execute it
XPRO2	PRO2	Sets up for integrations along row positions
XPRO3	PRO3	Calculates normal, cordwise forces and pitching moments
SREADF	READF	Free field input routine. Takes a sequence of alphanumeric characters and converts to a sequence of literal words and floating numbers
SREADGP	READGP	Translates an INFO file geometric group
SREADGX	READGX	Scans an INFO file geometric group for errors
SREADOP	READOP	Gets from the user any required run option changes
XREAD1	READ1	Reads a line that should contain one entry from the user
SREPMESS	REPMESS	Adjusts the number of cycles that can be processed according to the max available space in XBUFF array
SRESPAD	RESPAD	Performs initial calculation of one auto-spectral density and one cross-spectral density

Table B1. Continued

File Name	Subroutine	Description
SRESPEN	RESPEN	Completes the calculation of frequency response function from ensemble averaged auto- and cross- spectral densities of two processes
SRESPST	RESPST	Interface and overall control routine for generating the frequency response function
SRFFT	RFFT	Given a real function (data sequence) calculates the real fourier coeficient AK and BK
XRMS	RMS	Read from mass storage device NOUT words from record number NREC
SROTCOR	ROTCOR	Combines all the times of the rotor pulse in monotonic increasing order
SROTDEG	ROTDEG	Processes an input data stream of rotor position in degrees and identifies the instants of zero azimuth positions
SROTPUL	ROTPUL	Interrogates a rotor azimuth pulse train and returns the instants of time associated with zero azimuth angles
SROTSPD	ROTSPD	Estimates rotor speed from one per rev rotor pulser
SRTRVSC	RTRVSC	Retrieves scratch file data from SCF1, SCF2, SCF3, or SCF4
SSAMPAN	SAMPAN	Draws and annotates a sample of a curve just drawn on a cross plot
SSCADD	SCADD	Adds data to scratch file and modifies directory appropriately to show the addition
SSCALEV	SCALEV	Scales the data using the MAX and MIN
SSCALGN	SCALGN	Generates an X-scale for a data sequence
SSCANBK	SCANBK	Scans an array and finds the last character that is not blank
SSCBUFF	SCBUFF	Copy from buffer array XBUFF
SSCINAL	SCINAL	Sets some values in the scratch file storage block that apply to all row and column positions
SSCNBAD	SCNBAD	Scans entry lines from system input or edit file until one is found which begins with a valid specification substep
SSCPERM	SCPERM	Gets an indication of whether the scratch files are permanent (and require no initialization) or temporary (and require initialization)
SSHFSTR	SHFSTR	Transfers NC characters from IBB array, starting with character location NB, to IAA array with first character location NA

Table B1. Continued

File Name	Subroutine	Description
SSHFTHP	SHFTHP	Computes main or tail rotor shaft horsepower
SSIMPSN	SIMPSN	An adaption of the IBM SSP subroutine QSF to compute the vector of integral values for a given equidistant table of function values
SSINGGP	SINGGP	Scans first group of info file which is stored in /singif/ common block
SSINGPL	SINGPL	Plots a single X-Y curve on a new plot frame or an existing frame
SSKIPLN	SKIPLN	Reads through a specified number of lines of a file without transferring any data so that the reads will be considerably faster
SSLOPE	SLOPE	Computes the derivative of the given a table of values (X,Y) function defined by Y,R
SSLOPST	SLOPST	Sets up for differentiation along column positions
SSMOOTH	SMOOTH	Does a simple smoothing of the input data
SSORTID	SORTID	Sorts the columns of a matrix according to ascending order of a key set of values
SSORTMF	SORTMF	Sorts an index to a floating array of numbers so that the index gives ascending order of values in the array
XSORT0	SORT0	Sorts an array of floating numbers in ascending order with no companion array
XSORT1	SORT1	Sorts an array of numbers in ascending order along with one companion array
XSORT2	SORT2	Sorts an array of numbers in ascending order along with one companion array
XSORT3	SORT3	Sorts a floating array of numbers in ascending order along with two companion arrays
SSRCLRF	SRCLRF	Draws some reference lines and labeling for cylindrical format surface plot
SSRRCRF	SRRCRF	Draws some reference lines and labeling for rectangular format surface plot
SZSTALL	STALL	Initializes all plotting
SSTATST	STATST	Combined routine for interface and calculation of mean, variance, or standard deviation
SZSTPLT	STPLT	Pages forward for a new plot in sequence

Table B1. Continued

File Name	Subroutine	Description
SSTPRCF	STPRCF	Computes the blade static pressure coefficient, CP
SSTRTUP	STRTUP	Main routine of the overlay to initialize a run of the DATAMAP processing program
SZTICS	TICS	Draw tic marks on specified side of grid
STORQUE	TORQUE	Computes the torque coefficient, CQ, as a function of time
STREEUP	TREEUP	Updates pointers and tree structure for entry and substep loops in subroutine 'USER'
STRUEAS	TRUEAS	Computes true airspeed from indicated airspeed
STSAV1	TSAV1	Saves data temporarily on general scratch file - if necessary
STSAV2	TSAV2	Temporarily or permanently dispose of data after a column from the processed matrix of time histories is done with the selected process
STSAV3	STAV3	Saves data temporarily on general scratch file or a specified scatch file after an operation along multiple column positions is completed
SUNINIT	UNINIT	Reads the unit conversion section of the initial group of the info file
SUNSPIKE	UNPIKE	Extracts a spike interval given by the user and interploate the Y values for the spike interval
SUSER	USER	Main routine of the user interface overlay
SUSERLC	USERLC	Executes command steps that can be accomplished locally in the user interface block
USLEEP	USLEEP	Suspends processing for the amount of time specified
SWMS	WMS	Writes to mass storage device 'NOUT' words from 'IARR' onto record number 'NREC'
SXCORRL	XCORRL	Calculates cross-covariance function for input data (cross-covariance is cross-correlation with mean value removed from input data)
SXCORST	XCORST	Interface to cross-correlation program XCORRL and perform ensemble averaging of results if required
SXDENST	XDENST	Interface to cross-spectral density program 'XSDENS' and performs ensemble averaging of results if required
SXSDENS	XSDENS	Calculates single sided cross-spectral density for input data

Table B1. Concluded

File Name	Subroutine	Description
SXYCMLB	XYCMLB	Supplies annotation for one curve of an annotation plot (LPLOT) or a cross-annotation plot (XLPLOT)
SXYCROS	XYCROS	Plots one variable versus another with no dependent-independent relationship implied
SXYPLOT	XYPLOT	Draws single plot, multiple plot, or adds a curve to an existing plot
SXYPRNT	XYPRNT	Prints data when only one dependent variable is supplied
XXYPRN2	XYPRN2	Prints two double row elements of data
SYSFRST	YSFRST	Sets up time, azimuth, frequency, or harmonic versus row or column matrix
SZZINT	ZINT	Gets line intersection with boundary of plotting area

Table B2. Common Block Descriptions

Common Block	Description
ATTPAR	Area for processed attached parameter information
BSPARE	Array for storage of data or scales during processing
BUFFER	Array for storage of data or scales during processing
CPUTIM	Used to track CPU usage
DEFLT	Default user input matrix and general system label
FLTR	Filter information storage
DIRECD	Provides provisional user command directives and comments for use in user interface
DIRECT	Two dimensional instruction matrix containing interface control values
MENBUF	Buffer block for menu generation
PARM	Parameter transfer storage
SCRAT	Dummy scratch array
SMPNTR	Array of pointers set by INISYM
SPIKINF	Spike information
SPSIZS	X axis plotting information
STPRESS	Boom system static pressure
USTRNG	Comment string for output
VSIZE	Used exclusively for the Versatec plotting adaption
HLPWDS	String and contol values for generation of help prompting
KWCNTL	Gives prescribed keywords to check that data on scratch file are appropriate
PLSPCL	Common for control of the special plotting modes quick and copy
WLIST	Keyword block
CLCOMP	Used exclusively by the plot and plots emulation package for the Tektronix and PLOC

Table B2. Continued

Common Block	Description
CNGBLK	Communications and work area for command sequence editing function
CURRNT	Current substep information
DRW2	Common for double scale plots (DPLOT option)
FILLRC	Contains the parameters which describe the digital filter transfer functions
KARD	Block for communicating user input lines for scan and return of information about the lines
MASS	Offsets, pointers and check values for the direct access routines RMS, WMS, and FMS
MODES	Operating modes for the program
PLABLS	Stored labels and information for output
SCRTBL	Block for storage of dirctory blocks of input and/or output scratch files
SLIST	Contains listing of the developing command
STATUS	Various information on the status of the program
PRCOM	Common for process communication
ENTOPT	Entry option and tree structure for user command steps
FILES	Input and output file numbers
INFGRP	Block for storage of information provided by an info file group
LABELS	Plot labels
LEDIT	Control and information values for command sequence storage on retrieval
MDEP	Computer, installation or hardware dependent values
GENSCR	Information and pointers for temporary scratch file
SURPLT	Control and label values for surface on contour plot generation
CNTLOP	Directive and information values for data processing and output
MLABLES	Block for output labels
CNTRLIP	Directive and information values for data input and processing
DATASET	Control values and buffer arrays for retrieval of data from master file

Table B2. Concluded

Common Block	Description
SINGIF	Information extracted from the initial group of info file
DRW	Block of plotting information
SCRTCH	Scratch file information and data
SIZES	Various fixed numeric values for program

Appendix C: DATAMAP Version 4.0 Installation Specifications

Processors: VAX-11/750
VAX-11/780
VAX-11/785

Operating System:
VMS Version 4.4 or higher

Memory Requirements (in Blocks):
10,000 - Minimum required
15,800 - Required to retain source code
26,000 - Required to print compilation lists and maps

Terminals Supported For Interactive Graphics:
Tektronix 4010, and 4014
Graphon 140, 240, and 250
Dec VT131, VT220
(any Tektronix 4010 or 4014 emulator)

Plot Output Devices:
Output in DIP format can be converted to:
- CALCOMP
- Houston Instrument DP-1
- QMS Laser Printer
- Versatec

Graphics Package:
Tektronix Plot10

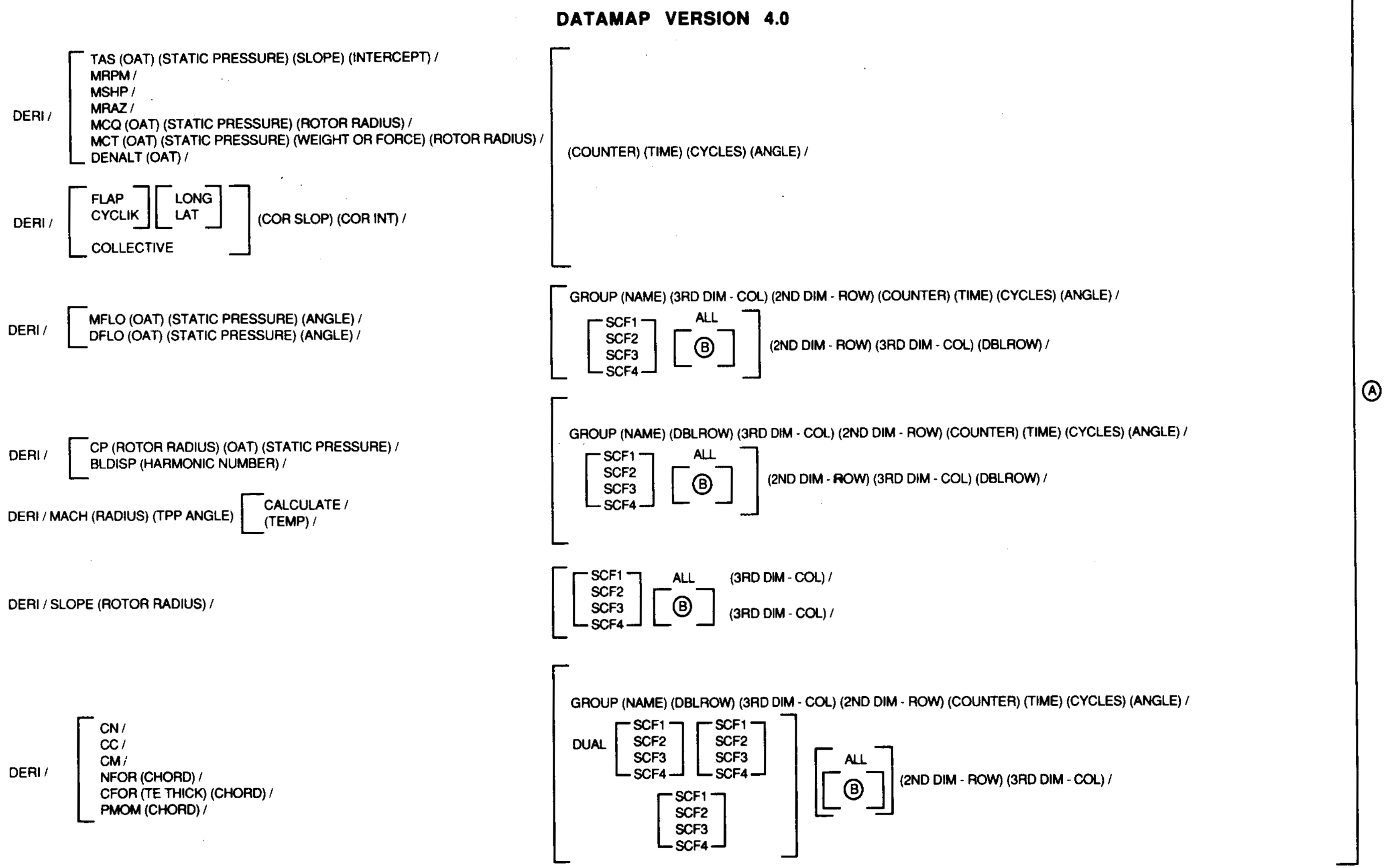


Fig. 1 DATAMAP command tree structure

DATAMAP VERSION 4.0

ANAL / HARM (#HARMONICS) (HARMONIC NUMBER) /
ANAL / AVER (# VALUES) /
ANAL / MMAX /
DERI / BLDIS /

(ITEM CODE) (COUNTER) (START TIME) (CYCLES) (ANGLE) /
GROUP (NAME) (DBLROW) (3RD DIM - COL) (2ND DIM - ROW) (COUNTER) (TIME) (CYCLES) (ANGLE) /
[SCF1 SCF2 SCF3 SCF4] [ALL / B] (2ND DIM - ROW) (3RD DIM - COL) (DBLROW) /

DISPLAY /
ANAL / FILT (UPPER BREAK FREQ) (LOWER BREAK FREQ) (#POLES) /
ANAL / SPECT (MAX FREQ) (WINDOW) /
ANAL / DAMP (DAMPING FREQ) /

ANAL / ACOUSTIC
- NARROW (FILTER BANDWIDTH) (CORRECTION LEVEL) /
- OCTAVE (CORRECTION LEVEL) /
- THIRD (CORRECTION LEVEL) /
- PNL (CORRECTION LEVEL) /
- DBA (CORRECTION LEVEL) /
- DBB (CORRECTION LEVEL) /
- DBC (CORRECTION LEVEL) /
- DBD (CORRECTION LEVEL) /

(ITEM CODE) (COUNTER) (TIME) (DURATN) /
GROUP (NAME) (DBLROW) (3RD DIM - COL) (2ND DIM - ROW) (COUNTER) (TIME) (DURATN) /
[SCF1 SCF2 SCF3 SCF4] [ALL / B] (2ND DIM - ROW) (3RD DIM - COL) (DBLROW) /

ANAL / DIFFERENTIATE [TIME / RADIUS] (# OF COEF'S) /

ANAL / SPIKE (X INT START) (X INT STOP) (ROW / COL) /

ANAL / ADJUST (ADD CONST) (TIME FACTOR) [UNSPECIFIED / (VALUE) /]

ANAL / COMBINE /

[SCF1 SCF2 SCF3 SCF4] [SCF1 SCF2 SCF3 SCF4] [ALL / B] (2ND DIM - ROW) (3RD DIM - COL) (DBLROW) /

IN 1 **IN2**

ANAL / COHERENCE (MAX FREQ) [NONE / COSINETAPER / HANNING / HALFCOSINE] (ADJ POINT AVERAGE) /

[SCF1 SCF2 SCF3 SCF4] [SCF1 SCF2 SCF3 SCF4] (2ND DIM - ROW) (DBLROW) /

A

Fig. 1 Continued

DATAMAP VERSION 4.0

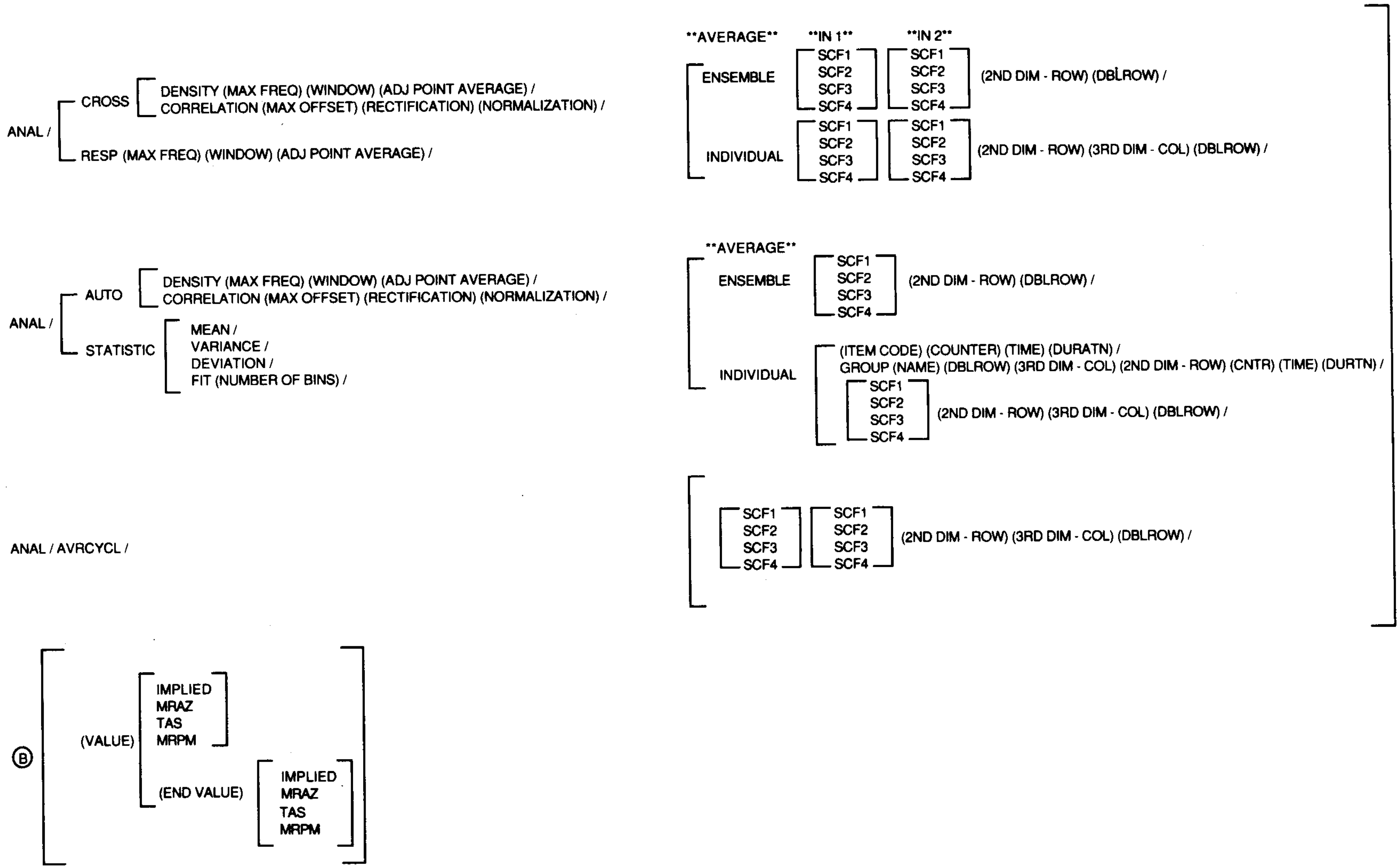


Fig. 1 Continued

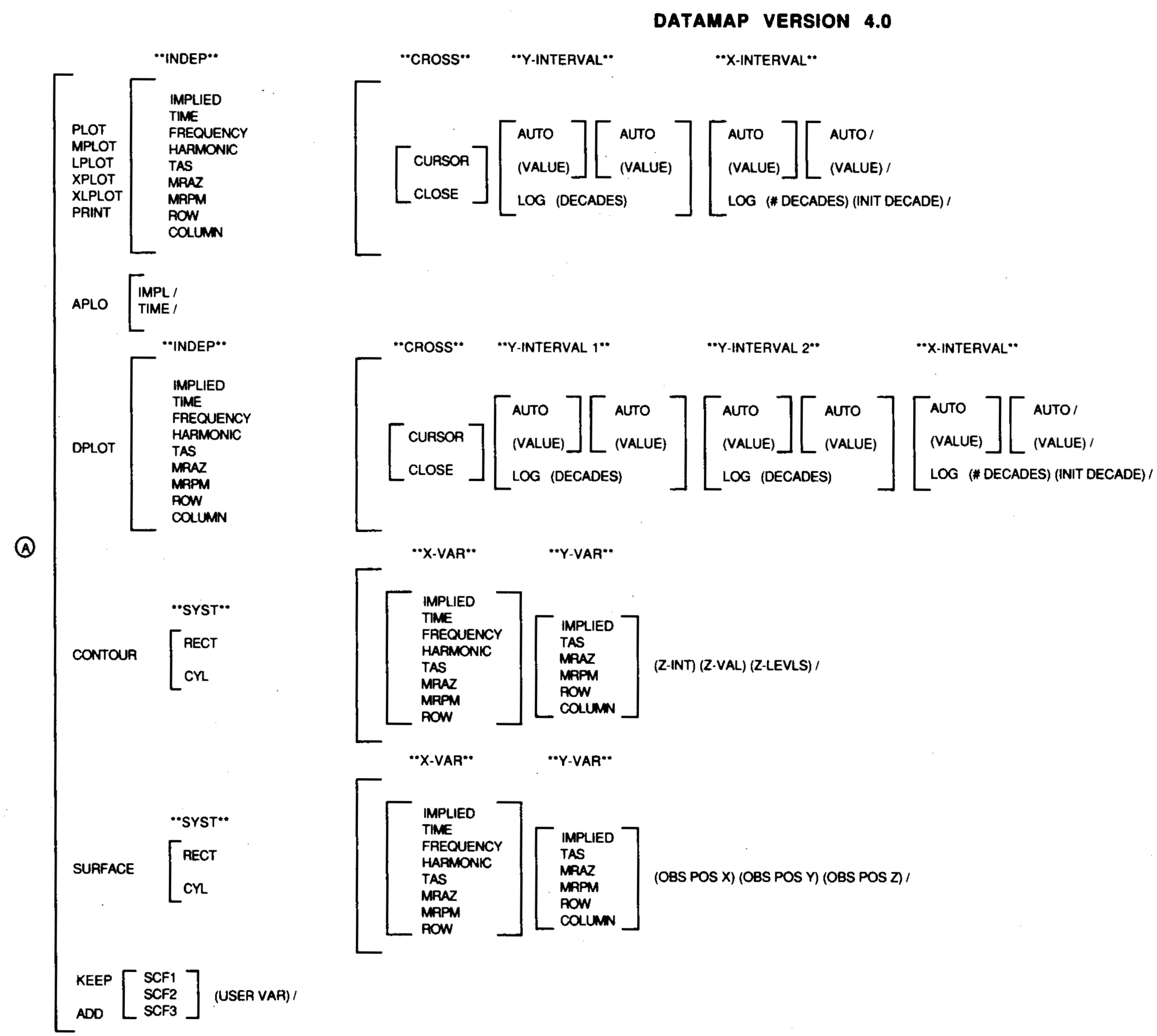
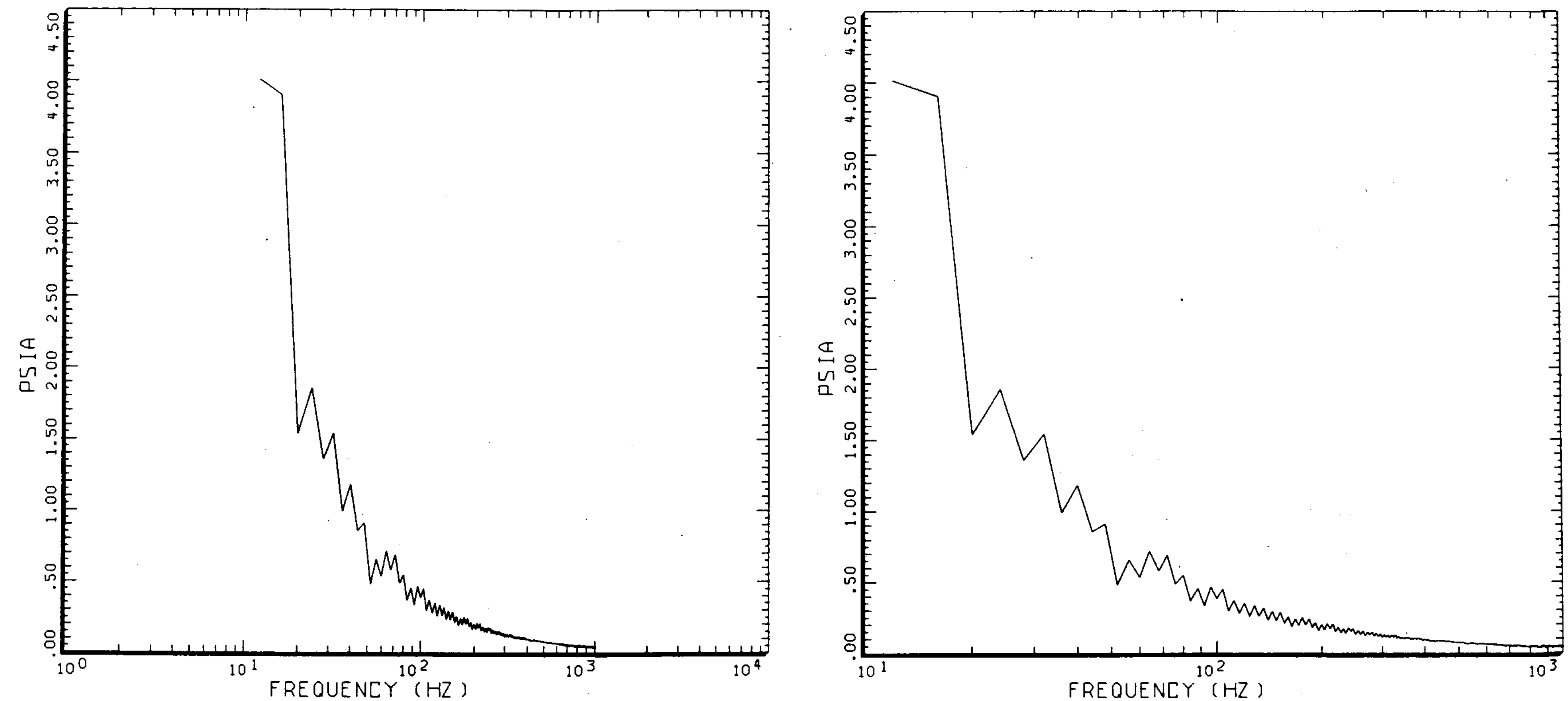


Fig. 1 Continued

DATAMAP VERSION 4.0

```
         ┌ NEW    ┐
EDIT /   │ CHANGE │  (BLOCK NAME) /
         └ DELETE ┘

BUILD /  (BLOCK NAME) /

EXECUTE / (BLOCK NAME) %(PARM 1) %(PARM 2)....%(PARM 20) /

         ┌ DATA /
         │ (COUNTER) /
         │ PARTITION /
         │ SCRATCH /
MENU /   │ INFO /
         │ MASK /
         │ EDIT /
         └ SET /

COMMENT / (COMMENT STRING) /

         ┌ BELL /
         │ NO BELL /
         │ WHISTLE /
         │ NO WHISTLE /
         │ AUTO SYMBOL /
         │ SYMBOL /
         │ LINE /
         │ CONNECT /
         │ MAIN /
         │ TAIL /
SET /    │ FULL /
         │ HALF /
         │ GRID /
         │ NOGRID /
         │ TICS /
         │ NOTICS /
         │ QUICK /
         │ SLOW /
         │ COPY /
         └ NOCOPY /

         ┌ MASK / (ITEM CODE) /
         │ UNMASK / (ITEM CODE) /
UTILITY /│ PARTITION / (NAME) (PAR. ACCESS SLOT) /
         │ COPY /
         │ OPERATOR / (LABEL) /
         └ PAUSE /
```

Fig. 1 Concluded



AMPLITUDE SPECTRUM: TAAT DATA, ALL SENSORS EXCEPT BAD ONES

COUNTER 2152 GROSS WT SHIP MODEL AH-1G
.03 X/CHORD LONG CG TOP SURFACE

.99 R/RADIUS

DATAMAP (VERS 4.0 - 09/01/86) 6MAR'87 NASA ARC

(a) Version 3.7 Log Option

AMPLITUDE SPECTRUM: TAAT DATA, ALL SENSORS EXCEPT BAD ONES

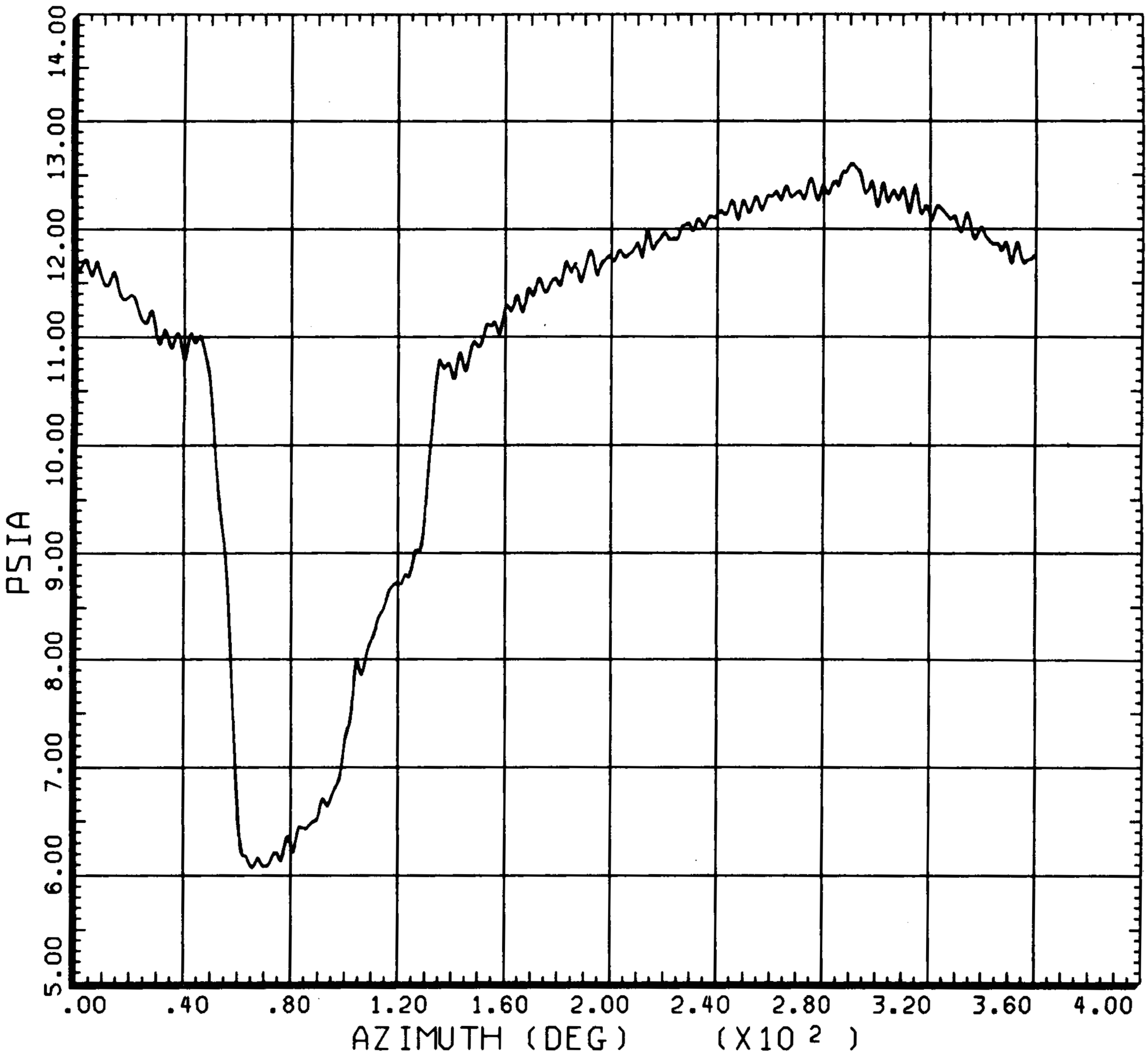
COUNTER 2152 GROSS WT SHIP MODEL AH-1G
.03 X/CHORD LONG CG TOP SURFACE

.99 R/RADIUS

DATAMAP (VERS 4.0 - 09/01/86) 6MAR'87 NASA ARC

(b) Version 4.0 Log Option

Fig. 2 Illustration of new log plotting option



____________	COUNTER	2152	GROSS WT LONG CG		SHIP MODEL SHIP ID	AH-1G 20004
AVERAGE HAS 256 POINTS IN ONE CYCLE CYCLE AVERAGE:	ABS PRESS		UPR*6	W256		
___ ___ ___	COUNTER	2152	GROSS WT LONG CG		SHIP MODEL SHIP ID	AH-1G 20004
AVERAGE HAS 1024 POINTS IN ONE CYCLE CYCLE AVERAGE:	ABS PRESS		UPR*6	W256		
___ . ___ . ___	COUNTER	2152	GROSS WT LONG CG		SHIP MODEL SHIP ID	AH-1G 20004
AVERAGE HAS 2048 POINTS IN ONE CYCLE CYCLE AVERAGE:	ABS PRESS		UPR*6	W256		

DATAMAP (VERS 4.0 - 09/01/86) 15JAN'87 NASA ARC

Fig. 3 Time histories with variable number of points per cycle

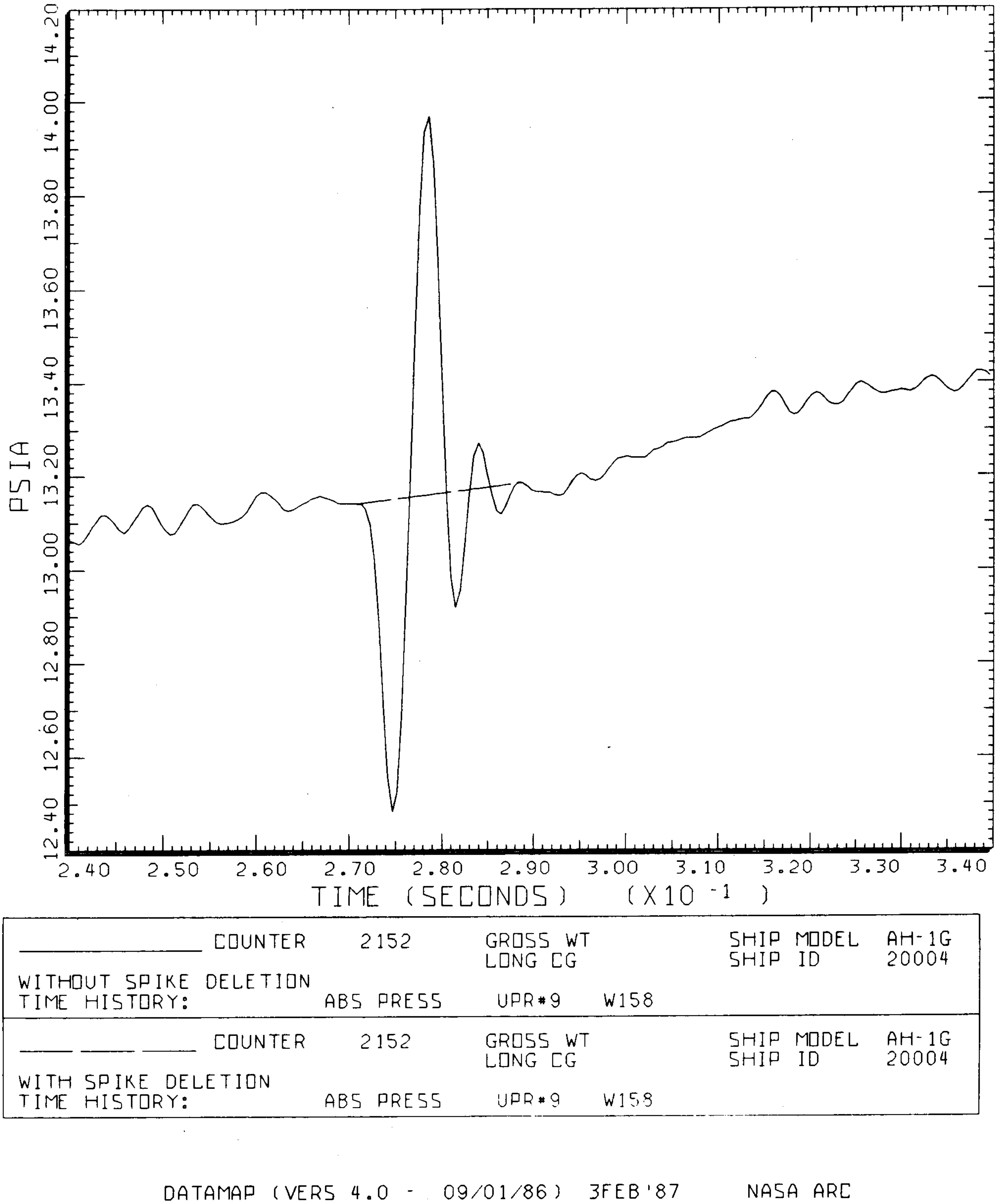


Fig. 4 Time history with an without spike deletion

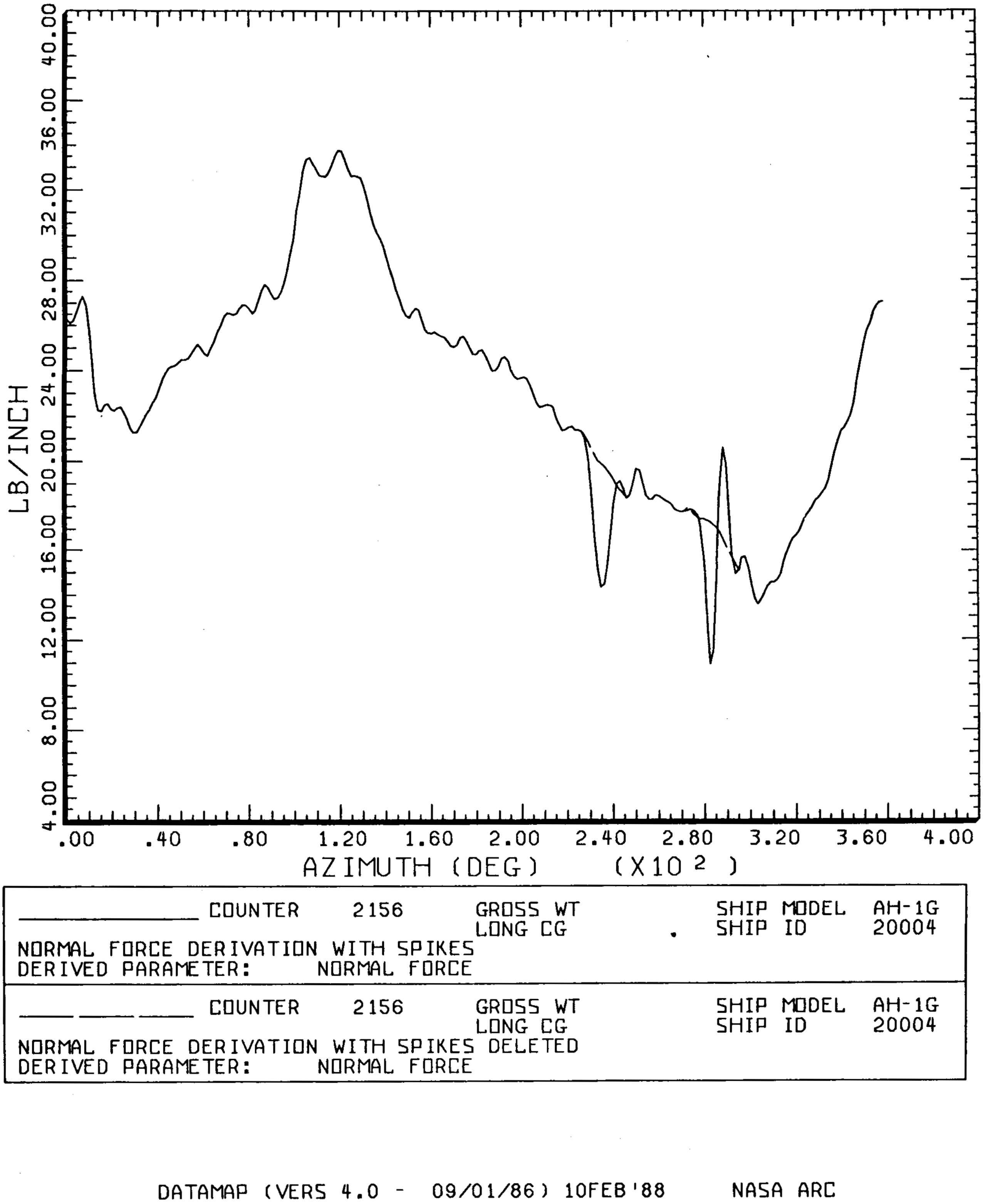


Fig. 5 Comparison of normal force with and without spike deletion

S3PX BLADE ABSOLUTE PRESSURE, OLS DATA, W / O 60 R / R
FRACTN OF RADIUS
R / RADIUS
BLADE ROOT
.40, .75, .864, .955 //
CHORD DISTRIBUTION
C/CBASE
BLADE ROOT
1.0,1.0,.80,.90//
FRACTN OF CHORD
X / CHORD
LEADING EDGE
.009991, .029972, .079930, .149869, .199825, .249782, .349694,
.399651, .449607, .499563, .549520, .599476, .699389, .919196 //
BLAP, BLAM //
UPPER SURFACE
BOTTOM SURFACE
P157, .016697, P173, -.016697 / P828, .016697, P856, -.016697 /
P164, .016697, P831, -.016697 / P908, .016697, P958, -.016697 //
P158, .026953, P174, -.026953 / P836, .026953, P857, -.026953 /
P165, .026953, P843, -.026953 / P909, .026953, P959, -.026953 //
P159, .039120, P175, -.039120 / P837, .039120, P858, -.039120 /
P166, .039120, P844, -.039120 / P919, .039120, P973, -.039120 //
NULL, .046362, NULL, -.046362 / P838, .046362, P868, -.046362 /
NULL, .046362, P845, -.046362 / P920, .046362, P974, -.046362 //
NULL, .048165, NULL, -.048165 / P839, .048165, P869, -.048165 /
NULL, .048165, P859, -.048165 / NULL, .048165, NULL, -.048165 //
P160, .048164, P176, -.048164 / P840, .048164, P870, -.048164 /
P182, .048164, P860, -.048164 / P921, .048164, P975, -.048164 //
NULL, .044446, NULL, -.044446 / P841, .044446, P871, -.044446 /
P194, .044446, P861, -.044446 / P926, .044446, P989, -.044446 //
NULL, .041355, NULL, -.041355 / NULL, .041355, P872, -.041355 /
P195, .041355, P875, -.041355 / P927, .041355, P990, -.041355 //
P161, .038071, P177, -.038071 / P852, .038071, P873, -.038071 /
P196, .038071, P876, -.038071 / P928, .038071, P991, -.038071 //
NULL, .034788, NULL, -.034788 / NULL, .034788, NULL, -.034788 /
P813, .034788, P877, -.034788 / P941, .034788, P738, -.034788 //
NULL, .031504, NULL, -.031504 / P853, .031504, P874, -.031504 /
P814, .031504, P891, -.031504 / P942, .031504, P739, -.031504 //
NULL, .028220, NULL, -.028220 / NULL, .028220, NULL, -.028220 /
P815, .028220, NULL, -.028220 / NULL, .028220, NULL, -.028220 //
P162, .021653, P178, -.021653 / P854, .021653, NULL, -.021653 /
P829, .021653, P893, -.021653 / P943, .021653, P740, -.021653 //
NULL, .007205, P179, -.007205 / P855, .007205, P885, -.007205 /
P830, .007205, P907, -.007205 / P957, .007205, P757, -.007205 //
END

Fig. 6 Information file format for S3 option

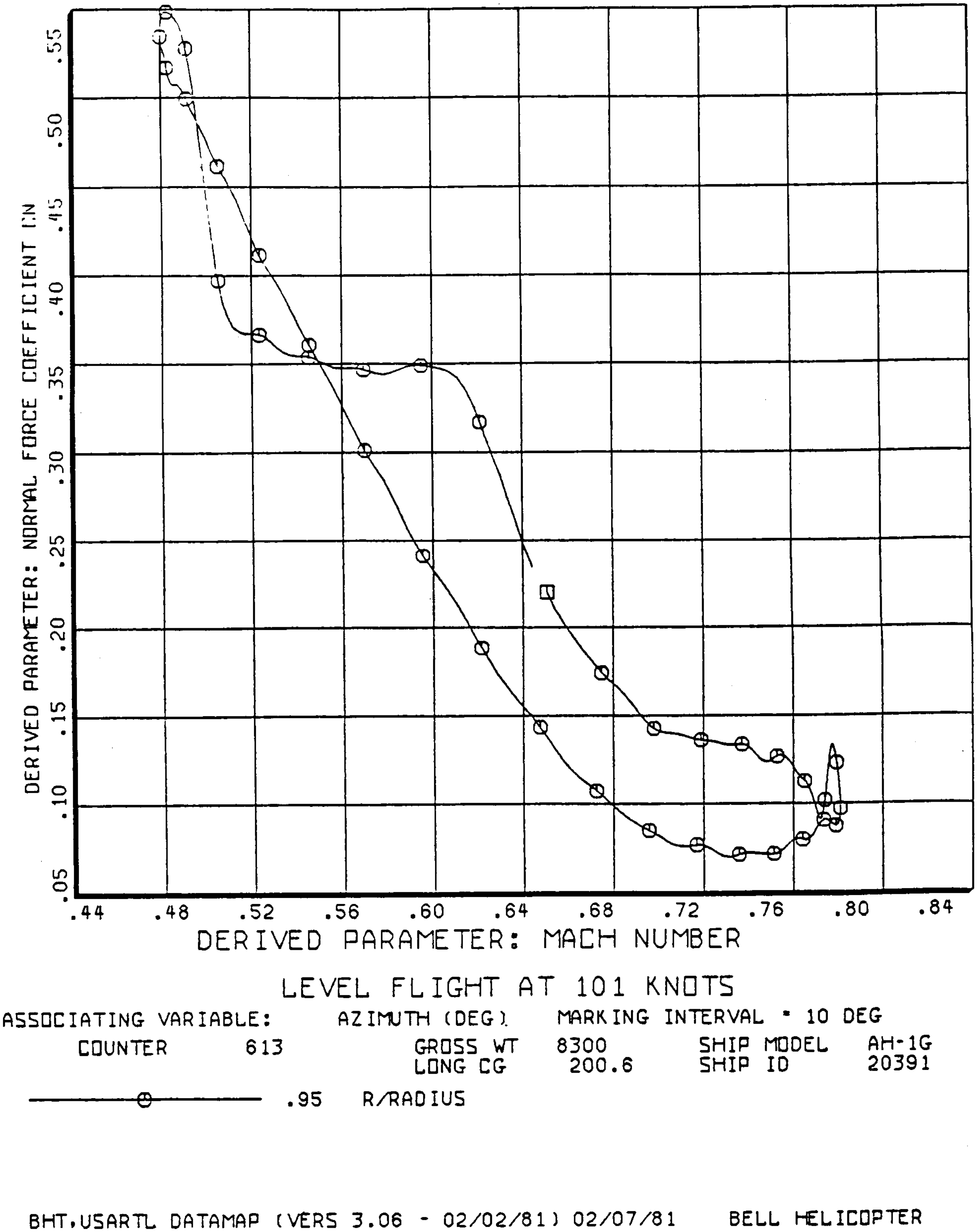


Fig. A1 Cross plot with azimuth as associating independant variable

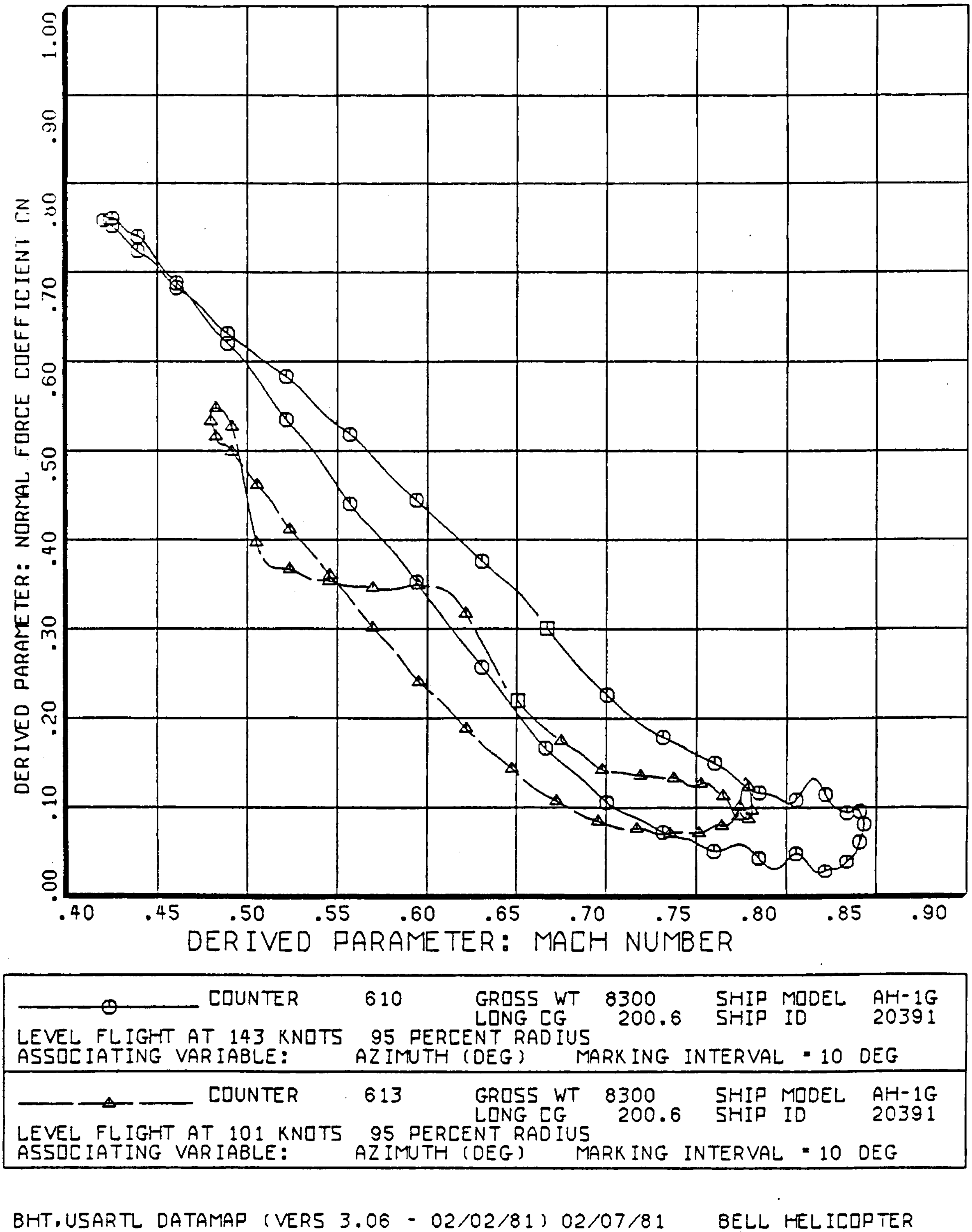
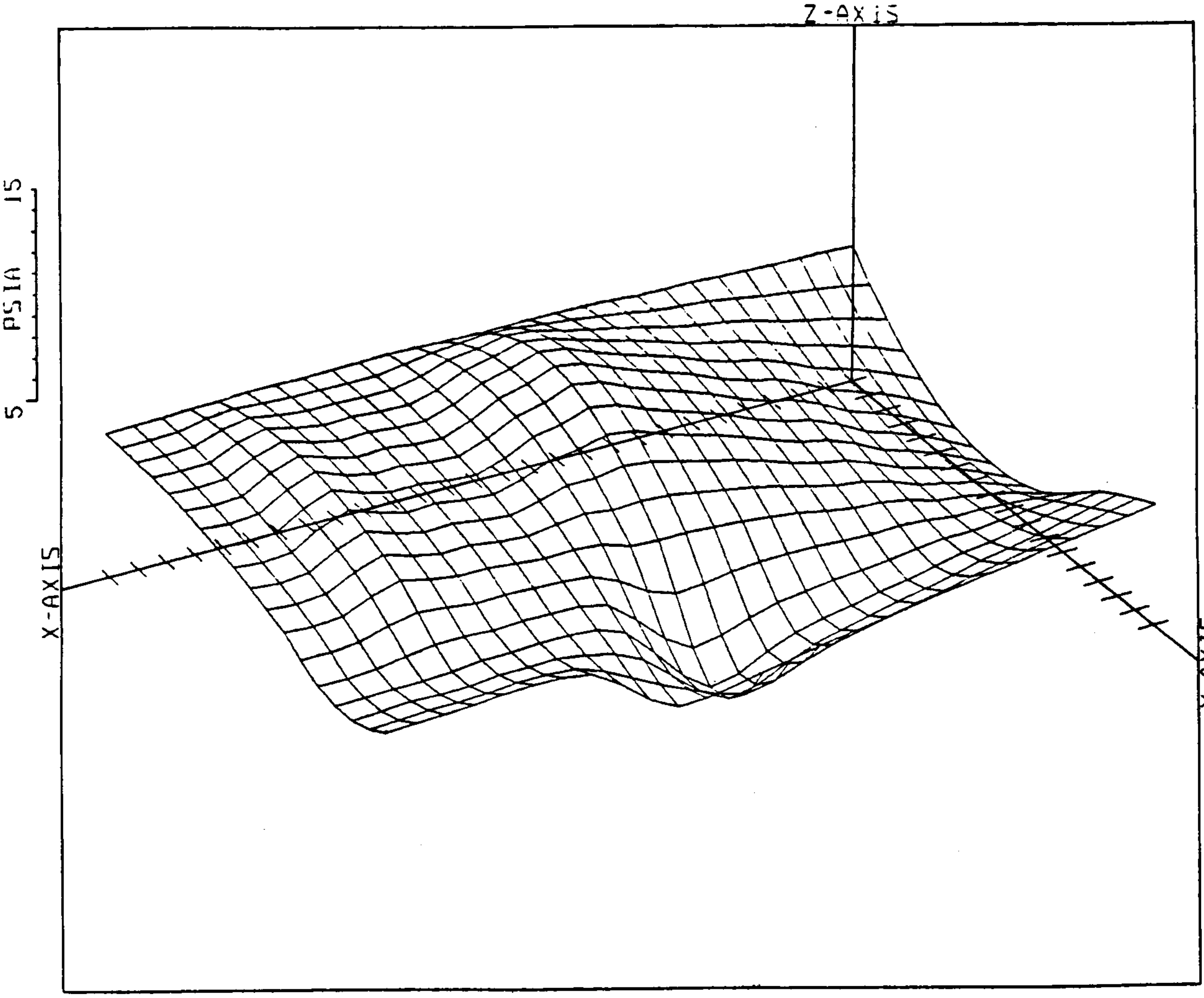


Fig. A2 Annotated cross plot using XLPLOT command



LEVEL FLIGHT AT 72 KNOTS

CYCLE AVERAGE: BLADE ABSOLUTE PRESSURE

COUNTER	611	GROSS WT	8300	SHIP MODEL	AH-1G
.01	X/CHORD	LONG CG	200.6	TOP SURFACE	

X QUANTITY - AZIMUTH (DEG)
MIN X 225.000 MAX X 314.996 INC X 3.333
Y QUANTITY - FRACTN OF RADIUS
MIN Y .400 MAX Y .955 INC Y .033
AXES DISPLACED TO MIN RANGE AND DOMAIN VALUES
MIN Z 5.736

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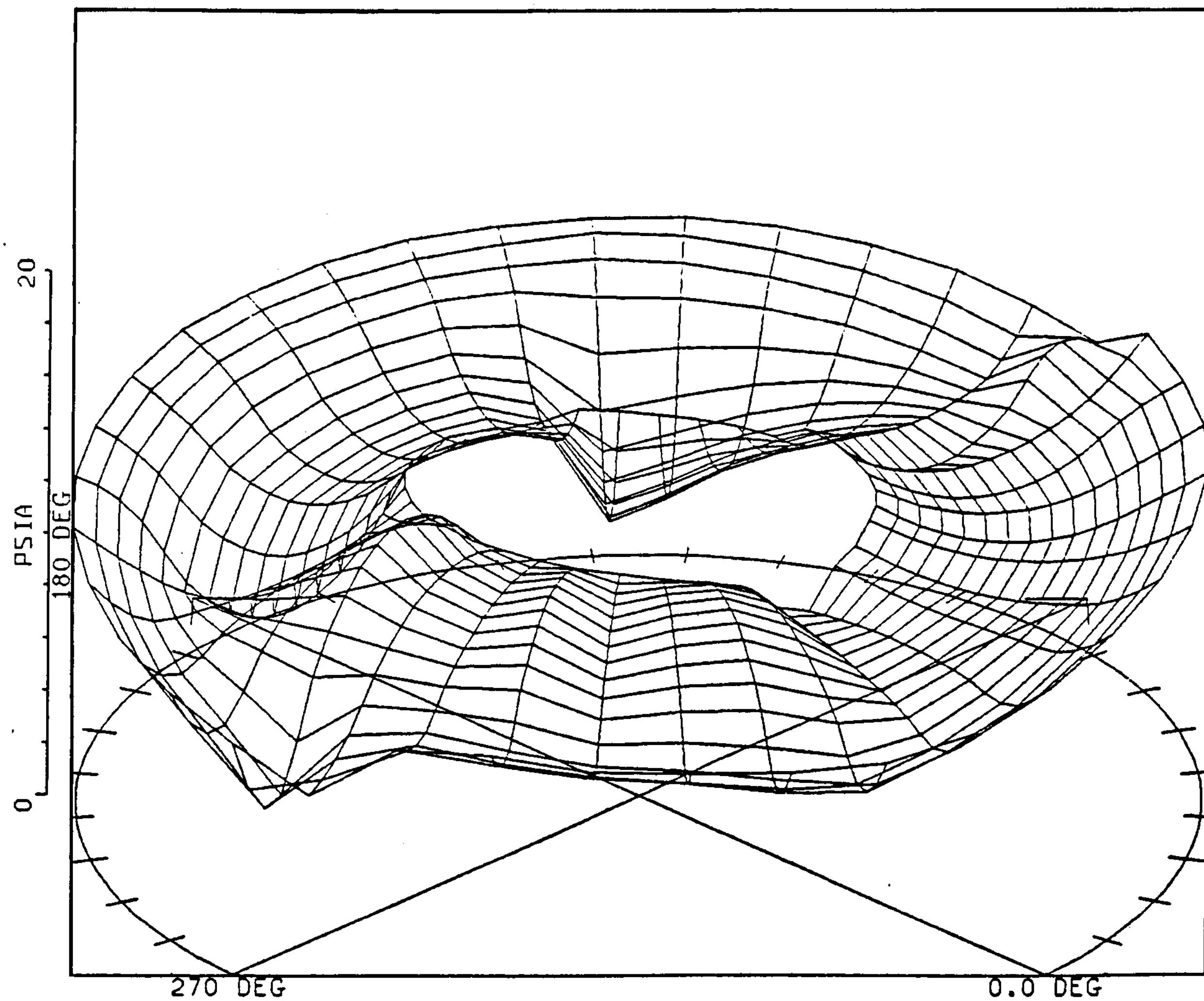
Fig. A3 Surface plot of a subrange of azimuth



LEVEL FLIGHT AT 72 KNOTS

CYCLE AVERAGE: BLADE ABSOLUTE PRESSURE

COUNTER	611	GROSS WT	8300	SHIP MODEL	AH-1G
.01	X/CHORD	LONG CG	200.6	TOP SURFACE	

ANGULAR INCREMENT 10 DEG
RADIAL QUANTITY FRACTN OF RADIUS
MAX RADIUS .955
RADIAL INCREMENT .0370

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Fig. A4 Surface plot of a full azimuth

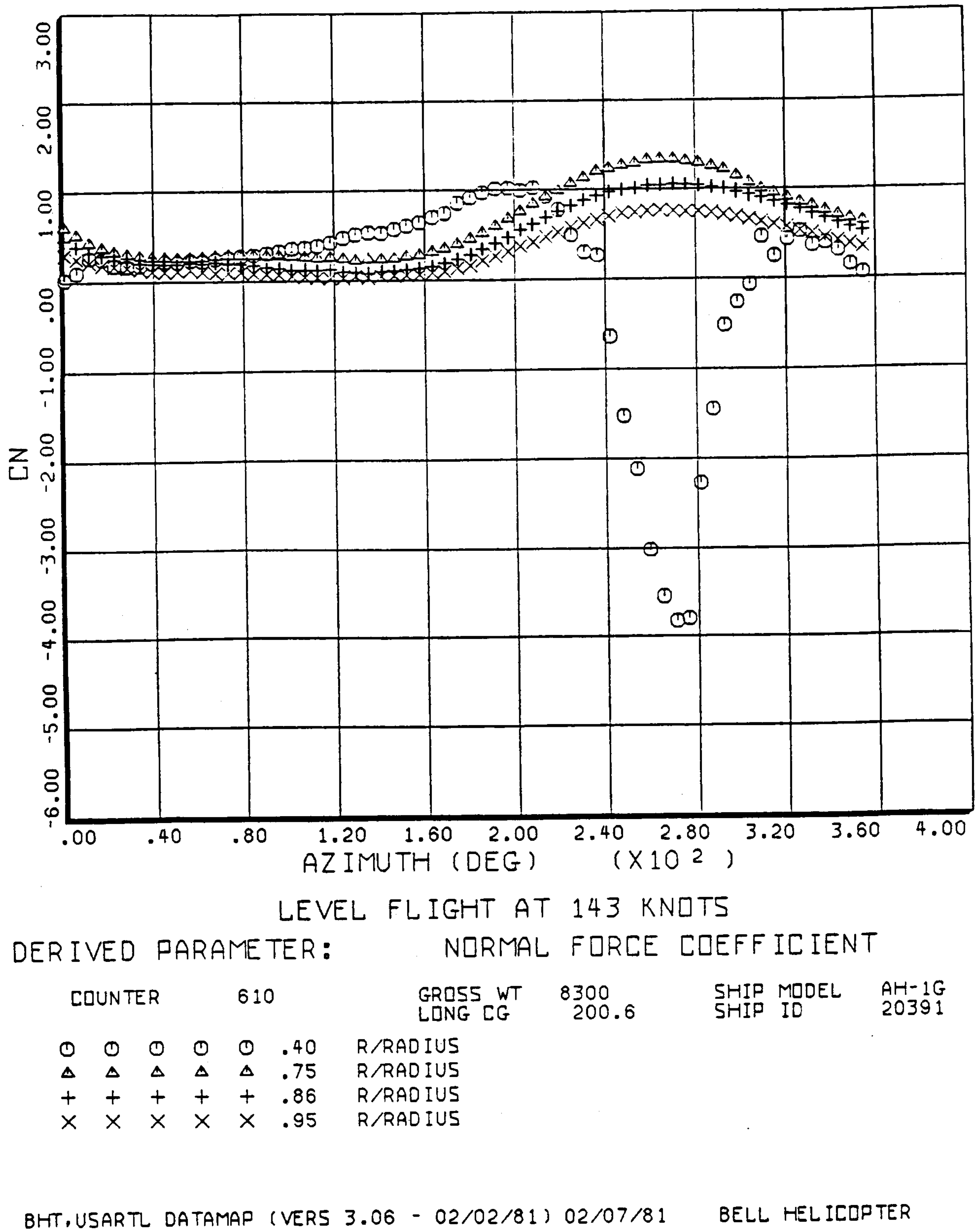

Fig. A5 Example of "SYMBOL" setting

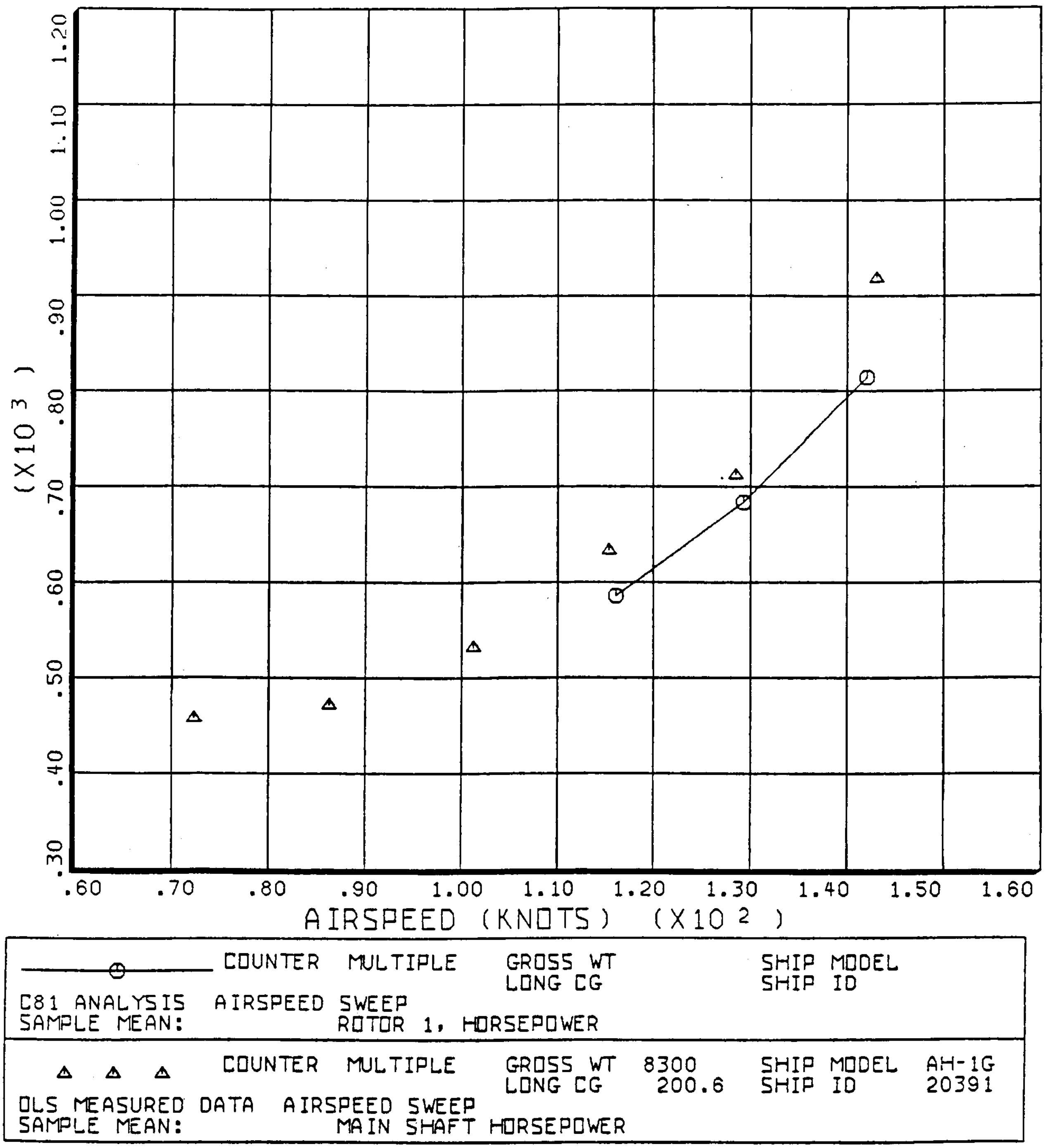

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Fig. A6 Comparison of flight and theoretical data using different symbol and line combination

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15. Supplementary Notes

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16. Abstract

This report details the changes made on the data analysis and management program DATAMAP (Data from Aeromechanics Test and Analytics - Management and Analysis Package). These changes are made to Version 3.07 (released February, 1981) and are called Version 4.0. Version 4.0 improvements were performed by Sterling Software under contract to NASA Ames Research Center. The increased capabilities instituted in this version include the breakout of the source code into modules for ease of modification, addition of a more accurate curve fit routine, ability to handle higher frequency data, additional data analysis features, and improvements in the functionality of existing features. These modification will allow DATAMAP to be used on more data sets and will make future modifications and additions easier to implement.

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